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Assessment of combining ability for fruit yield and its related traits in brinjal

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Abstract
The investigation on combining ability for yield and yield-related traits in brinjal revealed that dominance variance was higher than additive variance for the majority of characters indicating a preponderance of non-additive gene action. Thus these characters could be improved through recurrent selection or heterosis breeding. The parent Mattigulla and Melavanki identified as good general combiners for various characters studied. Similarly, the cross Melavanki× Malapur and Coorg × Mattigulla identified as good specific combiners. GCA to SCA ratio was less than for many of the traits one indicating the predominance of non-additive gene action which can improve through recurrent selection or heterosis breeding.

Keywords: Additive variance, combining ability, general combiner, recurrent selection

Introduction
Brinjal (*Solanum melongena* L.) belongs to family Solanaceae with the chromosome number 2n=24 is an important solanaceous crop cultivated throughout the world. However, it is widely grown in both temperate and tropical regions of the world mainly for its immature fruits as vegetables. Its primary centre of origin is India and China being the secondary centre of origin (Vavilov, 1928) [13]. Nutritionally brinjal is a good source of minerals and vitamins, fruits and leaves are excellent remedies for liver troubles and known to have a significant effect in reducing the blood and liver cholesterol rates. White coloured fruit are good for diabetic patients (Singh *et al*., 1963) [10]. The combining ability analysis indicates the variance due to the GCA and SCA which represent the relative measure of additive and non-additive gene actions respectively. It is a fact that dominance is a component of non-additive genetic variance. Breeders use these variance components to infer the gene action and to assess the genetic potentiality of the parents in hybrid combination. The ultimate choice of parents to be used in a breeding programme is determined by *per se* performance, particularly in respect of yield components. It is, therefore, necessary to assess the genetic potentialities of the parents in hybrid combination through systematic studies about general and specific combining abilities and their careful use in crop improvement. Thus, identification of good general combiners can help in the selection of parents for heterosis breeding. Therefore, the present study was carried out -to identify potential parents for hybridization and to develop superior hybrids.

Material and Methods
The present investigation was carried out ou at the College of Horticulture, Mudigere during 2017-2018. The materials consisted of five local brinjal genotypes collected from different parts of Karnataka (Melavanki, Coorg, Mattigulla, Malapur and Kudchi). These five genotypes were mated in a diallel fashion to produced twenty hybrids and these hybrids were field evaluated in a Completely Randomized Block Design with a spacing of 90 x 60 cm^2 in three replications along with a standard check Arka Anand. The standard package of practices was followed to raise the crop; five competitive plants were randomly selected for recording observations on different quantitative and qualitative parameters. Combining ability analysis was performed with the data obtained for parents and hybrids according to Model-I and Method-II proposed by Griffing (1956) [5]. This includes partitioning of variation among sources.

Results and Discussions

In the present study, genotypes exhibited significant general combining ability for growth, yield and quality parameters (Table 1). Considerable GCA effects for growth, yield and quality parameters also reported in brinjal by Pachiyappan *et al.* (2012) [6]. Among parents, Mattigulla (2.837) exhibited a maximum and significant GCA effects for plant height at 90 days after transplanting (DAT). Shanmugapriya *et al.* (2009) [7] also reported the same results for plant height in brinjal and the number of primary branches per plant at 90 DATis achieved in Malapur (0.468). Maximum positive and significant GCA effects observed in genotype Malapur (0.587) for the number of secondary branches (Singh *et al.*, 2005 and Shafeeq, 2005) [9, 8].

Genotype Coorg (2.331) and Mattigulla (0.088) recorded maximum significant GCA effects in the positive direction for leaf area at 90 DAT and leaf area index respectively. For earliness characters like days to first flowering, days to 50% percent flowering adverse GCA effect preferred, Kudchi recorded maximum adverse GCA effect for days to 50 percent flowering (-1.628) and days to first flowering(-2.216). Significant adverse GCA effects for these traits were also reported by Ashwani and Khandelwal (2005) [3] in brinjal.

Positive and high GCA effect is preferred for yield and yield contributing characters. Genotype Melavanki (0.72) showed positive significant GCA effect for fruit length whereas Kudchi (0.494) exhibited maximum GCA effect for the number of fruits per cluster. Maximum GCA effect for fruit weight was observed in genotype Mattigulla (10.156), and Mattigulla (0.547) recorded maximum GCA effect for yield per plant and Mattigulla (1.922) for yield per hectare. Significant GCA effects for average fruit weight reported by Singh *et al.* (2005) [9] and Shafeeq (2005) [8] in brinjal. Maximum and considerable GCA effect for the number of fruits per plant was observed in genotype Mattigulla (3.385) and for days to the first harvest was marked by the genotype Kudchi (3.220), and Melavanki (- 0.679 %) recorded negative significant GCA effect for phenol content of the fruit. Melavanki (0.08 and 1.152) recorded maximum and significant GCA effect for chlorophyll and ascorbic acid content of the fruits respectively.

For exploitation of heterosis, information on GCA should supplement with SCA and hybrid performance. Estimation of SCA effects for 20 crosses has resulted in the identification of good specific combiners for various traits (Table 2). Among crosses, the cross Coorg × Kudchi (4.002) exhibited maximum significant SCA effects for plant height at 90 DAT. Maximum significant SCA effects for the number of primary branches per plant at 90 DAT recorded by the cross Mattigulla × Melavanki (0.518) and for secondary branches, Coorg × Malapur (0.690) exhibited maximum significant SCA effects. These results are in agreement with the findings of Biswajee *et al.* (2004) [4] and Pachiyappan *et al.* (2012) [6].

Negative and significant SCA effects are desirable for earliness parameters. The cross Coorg × Malapur (- 2.550) recorded maximum significant beneficial SCA effects for days to first flowering, and for days to 50 percent, flowering cross Malapur × Melavanki (- 6.000) recorded negative significant SCA effects. Shanmughapriya *et al.* (2009) [7] and Singh *et al.* (2005) [9] also reported similar significant SCA effects for days to first flowering and days to 50 percent flowering. Cross Malapur × Melavanki (1.000) exhibited highest and significant SCA effects for the number of flowers per cluster. The cross Melavanki × Malapur (0.442) showed significantly positive SCA effects for fruit length.

Out of 20 crosses, Malapur × Mattigulla (0.490) and Mattigulla × Kudchi (12.750) recorded maximum SCA effects for the number of fruits per cluster and fruit weight respectively. The findings of Singh *et al.* (2005) [9] and Shanmughapriya *et al.* (2009) [7] on the SCA effects of fruit length, fruit weight are comparable with the results of the present study. The cross Coorg × Mattigulla (4.223) recorded greater SCA effects for the number of fruits per plant. Similar results were also reported by Pachiyappan *et al.* (2012) [6] for the number of fruits per plant. The cross Coorg × Melavanki (- 7.000) showed desirable SCA effects for days to first harvest. Cross Malapur × Coorg (0.540) and Melavanki × Kudchi (3.290) has recorded maximum SCA effect for yield per plant and hectare respectively. Shanmughapriya *et al.* (2009) [7] also reported significant SCA effects for yield per plant and yield per hectare. For phenol content of fruits, the cross Mattigulla × Coorg (- 1.890 %) recorded the highest adverse SCA effects and for ascorbic acid Malapur × Melavanki (2.420). Suneetha *et al.* (2008) [11] reported significant SCA effects for the ascorbic acid content of the fruits.

The plant height, leaf area, number of primary branches, days to first flowering, days to 50 percent flowering, fruit length, fruit volume, number of fruits per cluster, fruit weight, number of fruits per plant, number of days to first harvest, yield per hectare, total phenol content, ascorbic acid content of fruits and total chlorophyll are predominantly controlled by non-additive gene action. The ratio of general combining ability variance (GCA) to specific combining ability variance (SCA) is an indication of the predominance of additive or non-additive genetic variance. The ratio of GCA to SCA (Table 3) was very low for the phenolic content of fruits (Suneetha *et al.*, 2008) [11], number of branches per plant at 90 DAT (Shanmughapriya *et al.*, 2009) [7], number of fruits per plant, fruit length (Abhinav and Nandan, 2010) [1], average fruit weight (Ashwani and Khandelwal, 2005) [3], plant height at 90 DAT, days to first flowering, yield per plant and number of branches (Pachiyappan *et al.*, 2012) [6] indicating preponderance of non-additive gene action and hence these traits can be improved through recurrent selection for specific combining ability or heterosis breeding. Non-additive component of genetic variance was higher than additive component for days to first flowering and 50 percent flowering, (Singh *et al.*, 2005) [9], yield per hectare (Tomar *et al.*, 1996 and Ashwani and Khandelwal, 2005) [3] and number of primary branches at 90 DAT (Shafeeq, 2005) [8] also depicted role of non-additive gene action. Hence, these characters can improve through recurrent selection schemes.

Analysis of combining ability is one of the potential tools for identifying prospective parents to develop commercial F_1 hybrids (Griffing, 1956) [5]. General and Specific combining ability effects and the variances obtained from a set of F_1's would enable a breeder to select desirable parents and crosses for each of the quantitative components. General combining ability effects of parents and SCA effects of crosses were highly significant for the characters studied. From the present investigation, it is evident that GCA or SCA effects in parents or crosses were in a desirable direction for some aspects and undesirable direction for some other traits. Therefore it is essential to ascertain the status of parent or hybrid concerning combining ability effects over some component characters (Arunachalam and Bandopadyaya, 1979) [2].

Among parents, Mattigulla followed by Melavanki identified as the good combiner for overall characters and parents Coorg and Kudchi identified as poor combiners for all traits in

general. Population involving hybrid Melavanki × Malapur followed by Coorg × Mattigulla combinations can be constituted to create a promising gene pool for future breeding programs.

Table 1: Estimation of general combining ability effects for growth, yield and yield attributing characters in brinjal

Parents	Melavanki	Coorg	Mattigulla	Malapur	Kudchi	S.Em (±)	CD @ 5%	CD @ 1%
Characters								
Plant height (cm) at 90 DAT	2.72 **	1.08 *	2.83 **	1.48**	-8.12**	0.43	1.21	2.01
Number of primary branches per plant	0.09 *	-0.25**	-0.21 **	0.46**	-0.08	0.04	0.12	0.20
Number of secondary branches per plant	-0.01	-0.32**	-0.07	0.58 **	-0.17**	0.04	0.12	0.19
Leaf area (cm²) at 90 DAT	2.05*	2.33 **	-4.00**	-1.26	0.88	0.82	2.28	3.78
Leaf area index (LAI)	0.01	-0.04	0.08**	-0.009	-0.05*	0.02	0.06	0.10
Days to first flowering	0.02	0.32	0.54	1.32 **	-2.21**	0.41	1.16	1.92
Days to 50 percent flowering	0.45	0.62	0.66	-0.121	-1.62 **	0.45	1.26	2.10
Number of flowers per cluster	-0.14	-0.02	0.10	0.01	0.04	0.07	0.21	0.35
Number of fruits per cluster	-0.23**	0.034	-0.11**	-0.10**	0.49**	0.02	0.05	0.09
Number of fruits per plant	-0.22	-1.76**	3.38 **	0.60 *	-1.99**	0.23	0.64	1.07
Fruit set (%)	-0.93	-1.62 *	6.70**	1.24	-5.41**	0.75	2.09	3.46
Number of days to first harvest	-0.18	-1.58	0.72	-2.10 *	3.22 **	1.04	2.90	4.81
Fruit length (cm)	0.72 **	0.01	0.03	0.04	-0.81**	0.05	0.15	0.25
Fruit weight (g)	2.18 *	-6.97 **	10.15 **	4.21 **	-9.58**	0.87	2.43	4.04
Fruit volume (cc)	9.77**	-4.94	25.08**	8.13**	-38.0**	2.55	7.08	11.74
Yield per plant (kg)	-0.17 **	-0.176**	0.54 **	0.052	-0.25**	0.04	0.11	0.18
Yield (t/ha)	1.12 **	-0.13	1.92 **	-1.62**	-1.27**	0.19	0.53	0.89
Ascorbic acid content of fruits (mg / 100 g)	1.15 **	0.30 *	-1.09**	-0.28 *	-0.07	0.11	0.33	0.55
Phenol content of fruits (mg / 100 g)	-0.67**	-0.84**	0.68**	0.94**	-0.10	0.10	0.30	0.50
Total Chlorophyll (mg/g)	0.08**	-0.08**	0.19**	0.08**	-0.08**	0.01	0.04	0.07

* and ** indicates significance at 5% and 1% level respectively, DAT: days after transplanting

Table 2: Estimation of specific combining ability effects for growth yield and yield attributing characters

Crosses	Characters								
	X1	X2	X3	X4	X5	X6	X7	X8	X9
Melavanki×Coorg	3.82 **	0.50 **	-0.17	-2.43	-0.38**	-0.07	0.08	0.41*	0.07
Melavanki×Mattigulla	-2.48*	-0.03	0.43 **	12.53 **	-0.45**	-1.13	-2.28*	-0.01	-0.18**
Melavanki×Malapur	3.86 **	0.46 **	0.30 **	1.56	-0.36**	2.75**	-2.33*	-0.54**	-0.06
Melavanki×Kudchi	-1.47	-0.13	-0.27 *	-7.47 **	-0.34**	-1.22	-1.51	0.42*	0.31 **
Coorg ×Melavanki	-1.16	-0.37 **	0.38 **	-4.18 **	0.01	-1.16	0.50	0.41*	-0.20**
Coorg ×Mattigulla	-2.22 *	0.48 **	0.13	-3.38	-0.43**	1.55	-1.94	-0.16	0.00
Coorg ×Malapur	-3.14**	0.28 *	0.69**	3.21	-0.30**	-2.55*	-0.33	0.45*	0.02
Coorg ×Kudchi	4.00 **	-0.18	-0.06	0.45	-0.29**	1.58	1.48	0.32	0.39**
Mattigulla×Melavanki	-5.51 **	-0.96 **	-0.50**	-5.23*	-0.41*	1.00	0.50	-0.28	-0.10*
Mattigulla×Coorg	1.00	0.51 **	-0.10	-7.2**	-0.44**	4.67**	1.83	-0.75**	-0.05
Mattigulla×Malapur	3.85 **	-0.49 **	-1.339**	6.31 **	-0.44**	-0.61	1.29	-0.03	0.26**
Mattigulla×Kudchi	-0.27	0.18	0.15	-3.73	-0.41**	2.15*	1.59	0.19	-0.01
Malapur×Melavanki	-1.03	0.07	-0.50 **	-11.32 **	-0.04	0.66	-6.00**	1.00**	-0.15**
Malapur×Coorg	-3.14**	0.15	0.51**	-6.07 **	-0.03	-1.66	-2.17 *	0.21	0.50**
Malapur ×Mattigulla	2.29 *	0.10	-0.48 **	6.53 **	-0.03	-0.50	-0.50	0.24	0.49**
Malapur×Kudchi	-3.81**	0.46 **	0.24*	-3.53	-0.31**	2.62 *	2.40 *	0.31	-0.09
Kudchi×Melavanki	-1.50	0.11	0.64 **	-2.96	0.006	-1.52	-4.02**	-0.42	-0.20**
Kudchi×Coorg	-0.002	0.07	-0.14	-13.27 **	0.01	-3.41**	-3.18 **	0.30	-0.20**
Kudchi×Mattigulla	-0.61	0.05	-0.39 **	0.57	0.005	-0.61	-0.71	0.41*	0.16**
Kudchi×Malapur	0.002	0.21 *	-0.41 **	0.95	-0.005	1.66	-0.36	-0.22	0.15**
S.E.m	0.90	0.09	0.08	1.69	0.04	0.86	0.94	0.15	0.04
CD at 5%	2.04	0.21	0.20	3.83	0.10	1.95	2.12	0.35	0.09
CD at 1%	2.93	0.30	0.28	5.51	0.15	2.80	3.05	0.51	0.13

X1- plant height at 90 DAT (cm), X2- number of primary branches per plant at 90 DAT, X3- number of secondary branches, X6- leaf area, X7- leaf area index, X8- days to first flowering, X9- days to 50 percent flowering,

* and ** indicates significance at 5% and 1% level respectively.

Table 2: Contd.

Crosses	Characters										
	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X22
Melavanki×Coorg	0.88	0.37	0.88	-0.07	1.73 **	-0.49	-0.12	-0.11	10.3	13.41*	0.25
Melavanki×Mattigulla	1.58	-0.82	1.58	0.19 *	3.29 **	-2.20 **	-0.88**	-2.70 **	0.22	-12.03*	0.05
Melavanki×Malapur	-1.02	7.91 **	-1.02	-0.08	0.06	-1.61 **	-1.56**	1.604**	2.92	5.75	0.04
Melavanki×Kudchi	-2.92	-2.325	-2.92	0.19*	0.22	2.420**	-2.45**	1.123**	-16.31*	12.75*	2.94**
Coorg ×Melavanki	-7.00**	-0.13	-7.00**	-7.00 **	-1.61 **	-2.20 **	0.82 **	0.00	-0.31	-8.27	-2.08**
Coorg ×Mattigulla	1.48	1.31	1.48	0.10	2.399**	-0.91**	-0.68*	0.16	16.27*	-22.90**	-2.44**
Coorg ×Malapur	0.38	-1.58	0.38	0.10	-0.30	1.36**	0.31	-1.12**	0.09	0.74	-1.67 **
Coorg ×Kudchi	-2.02	5.64 **	-2.02	0.09	-1.15*	-1.80**	-1.89 **	0.52*	-11.10	-8.65**	0.95 *
Mattigulla×Melavanki	-4.00	-6.09 **	-4.00	0.25*	-0.72	-1.04**	-1.80**	0.30	2.92	1.18	-2.61**
Mattigulla×Coorg	-0.50	3.650*	-0.50	-0.05	2.32 **	0.47	-1.79**	1.69**	14.17*	5.93	0.86
Mattigulla×Malapur	-1.92	-1.31	-1.92	0.31**	-0.34*	-0.60	-0.08	0.43	6.37**	-10.58**	0.02
Mattigulla×Kudchi	-2.82	1.33	-2.82	-0.14	0.1	-1.00**	-0.21	2.23 **	0.47	2.232	0.44**
Malapur×Melavanki	-6.50 *	-1.11	-6.50 *	-0.28 **	0.31 *	-0.33	-0.08	-0.04	1.09	11.268**	-0.21
Malapur×Coorg	1.50	8.36 **	1.50	0.54**	-0.27*	-1.83**	0.50	0.90*	4.365 *	-33.83 **	0.10
Malapur ×Mattigulla	3.50	0.37	3.50	0.04	-0.20	-1.41**	-0.91 *	-2.08 **	3.48	0.85	-0.25
Malapur×Kudchi	6.08 *	-3.47 *	6.08 *	0.05	-0.10	0.08*	0.00	0.00	-5.79 **	12.75**	-0.06
Kudchi×Melavanki	-2.00	3.95 *	-2.00	0.15	-0.10	0.04	-0.05	-0.10*	-3.28	-5.44 *	0.15
Kudchi×Coorg	-0.72	8.19 **	-0.72	-0.05	0.03	0.02	-0.09*	0.008	-1.69	5.32 *	-0.05
Kudchi×Mattigulla	0.86	-0.82	0.86	-1.03**	0.44 **	0.04	0.03	0.001	-2.56	-47.31 **	0.45**
Kudchi×Malapur	2.32 **	3.13	2.32 **	-0.88**	-0.50**	-0.09*	-0.02	-0.03	3.16	-8.97 **	0.25
S.E.m(±)	4.21	3.03	4.21	0.16	1.77	0.48	1.09	0.43	10.28	23.25	0.78
CD at 5%	1.08	3.51	4.87	0.18	0.90	0.25	4.09	11.89	0.76	0.50	0.07
CD at 1%	1.56	5.04	7.00	0.26	1.30	0.37	5.87	17.08	1.10	0.72	0.11

X10- number of flowers per cluster, X11- number of fruits per cluster. X12- number of fruits per plant, X13- fruit Set (%), X14- number of days to first harvest,X15- yield per plant (kg), X16- yield (t/ha), X17- fruit length, X18- fruit weight (g), X19- fruit volume(cm), X20- ascorbic acid content of fruits (mg / 100 g), X21- phenol content of fruits (mg / 100 g), X22- total chlorophyll. * and ** indicates significance at 5% and 1% level respectively

Table 3: Variance due to general and specific combining ability for growth, yield and yield attributing characters in brinjal

Character	GCA	SCA	GCA: SCA	Degree of Dominance
Plant height (cm) at 90 DAT	20.97	19.69	1.06	0.92
Number of primary branches per plant at 90 DAT	0.08	0.48	0.17	2.75
Number of secondary branches per plant at 90 DAT	0.11	0.61	0.19	1.12
Leaf area (cm^2) at 90 DAT	6.16	95.65	0.06	0.77
Leaf area index (LAI)	0.002	1.422	0.001	6.82
Number of days to first flowering	1.54	8.10	0.19	2.09
Number of days to 50 percent flowering	0.66	8.81	0.07	2.64
Number of flowers per cluster	0.001	0.424	0.002	1.51
Number of fruits per cluster	0.085	0.13	0.62	1.45
Number of fruits per plant	4.67	13.1	0.35	1.13
Fruit set (%)	19.22	23.33	0.82	1.87
Number of days to the first harvest	3.174	1.96	1.61	1.73
Fruit length (cm)	0.29	0.11	2.64	6.07
Fruit weight (g)	65.58	365.28	0.17	1.51
Fruit Volume (cc)	557.53	341.33	1.63	0.76
Yield (kg/plant)	0.104	0.079	1.31	1.4
Yield (t / ha)	2.26	13.32	0.17	1.77
Phenol content of fruit (mg / 100 g)	0.62	1.13	0.54	1.09
Ascorbic acid content of fruit (mg / 100 g)	0.65	5.59	0.11	1.18
Total chlorophyll (mg/g)	0.01	0.002	5.00	1.96

SCA: Variance due to specific combining ability, GCA: Variance due to general combining ability

References

1. Abhinav S, Nandan M. Studies on heterosis about combining ability for yield and quality attributes in brinjal (*Solanum melongena* L.). E Journal Plant Breeding. 2010; 1(4):783-788.
2. Arunachalam V, Bandopadyaya. The facility behind the use of modified line x tester design. The Indian Journal of Genetics and Plant Breeding. 1979; 34:280-287.
3. Aswani RC, Khandelwal RC. Combining ability studies in brinjal. Indian Journal of Horticulture. 2005; 62(1):37-40.
4. Biswajeet P, Singh YV, Ram HH. Combining ability studies for yield and yield attributing traits in round-fruited eggplant (*Solanum melongena* L.) under Tarai condition of Uttaranchal (India). Capsicum & Eggplant News letter. 2004; 23:137-140.
5. Griffing B. Concepts of general and specific combining ability about diallel crossing system. Australian Journal of Biological Science. 1956; 9:463-493.
6. Pachiyappan R, Saravanan K, Kumar R. Combining ability analysis in eggplant (*Solanum melongena* L.). Golden Research Thoughts. 2012; 2(2):1-6.

7. Shanmughapriya P, Ramya K, Kumar SN. Studies on combining ability and heterosis for yield and growth parameters in brinjal (*Solanum melongena* L.). Crop Improvement. 2009; 36(1):66-72.
8. Shafeeq A. Heterosis and combining ability studies in brinjal (*Solanum melongena* L.). M. Sc. (Agri.) Thesis, University of Agricultural. Sciences, Dharwad, 2005.
9. Singh AK, Pan RS, Mathura Rai. Combining ability studies of yield and its contributing traits in tomato (*Lycopersicon esculentum* Mill.). Vegetable Science. 2005; 2(1):82-83.
10. Singh S, Krishnamurthi S, Katyal SL. Fruit Culture in India. Indian Council Agricultural Research, New Delhi, 1963, 412.
11. Suneetha Y, Kathiria KB, Patel JS, Srinivas T. Studies on heterosis and combining ability in late summer brinjal. Indian Journal Agricultural. Research. 2008; 42(3):171-176.
12. Tomar BS, Kalda KA, Balakrishnan, Gupta SS. Combining ability analysis for flowering and fruit set in eggplant (*Solanum melongena* L.). Veg. Sci. 1996; 23(2):152-154.
13. Vavilov NI. Proceedings of 5th International Congress of Genetics, New York, 1928, 342-369.