J. Sylhet Agril. Univ. 1(2):221-226, 2014 **Research Article** **ISSN: 2308-1597**

COMBINING ABILITY OF EGGPLANT (*Solanum melongena* L.) FOR PLANT AND FLOWERING CHARACTERS DURING SUMMER

M S Uddin[*1], M M Rahman[2], M M Hossain[2] and M A K Mian[3]

[1]*Department of Agroforestry and Environmental Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh*
[2]*Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh*
[3]*Department of Genetics and Plant Breeding, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh*

Abstract

Combining ability in eight eggplant genotypes were studied at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh during March 2007 to September 2008. Eggplant genotypes were crossed and evaluated for different plant and flower characters. Considering general combining ability (GCA) effects, the parents P_3, P_4 and P_7 were the good general combiner for promoting early flowering and fruiting and P_3, P_4 and P_6 for plant height and canopy. Considering specific combining ability (SCA) effects, the cross $P_1 \times P_6$, $P_1 \times P_4$, $P_1 \times P_8$ and $P_1 \times P_7$ were important for early flowering and fruiting; $P_3 \times P_8$ for plant height and canopy and $P_5 \times P_7$ for plant canopy. Therefore, for the improvement of flowering and plant characters the parents P_3, P_4, and P_7 and the crosses $P_1 \times P_6$, $P_1 \times P_4$, $P_1 \times P_8$ and $P_1 \times P_7$ could be selected for summer cultivation in Bangladesh.

Keywords: Combining ability, eggplant, flower character, summer

Introduction

Eggplant (*Solanum melongena* L.) is one of the most important vegetable crops of Bangladesh which contributes substantially in the lean period. Plant characters contribute to yield and early flowering and fruiting contribute to its economic value. In order to select superior parents, it is imperative to study the relative ability of the parents to transfer economic traits in the hybrid combination. Combining ability is one of the important and powerful tools in identifying the best combiner that may be used in crosses to exploit heterosis. It helps to know the genetic architecture of various characters that enable the breeder to design effective breeding plan for future improvement of the existing materials. This information is also useful to the breeder for selection of diverse parents and hybrid combinations. It is possible to select superior parents and develop high yielding variety through genetic manipulation. Hence, it is necessary to have knowledge about genetic make up of both quantitative and qualitative characters. Combining ability of eggplant was studied by several workers in India (Singh and Kumar, 1988; Singh *et al.* 1991). Although eggplant is a major vegetable in Bangladesh, an organized and systematic attention has not been given so far for its improvement from a breeding point of view, particularly for summer production. In Bangladesh there is little information in this regard during winter studied by Rashid *et al.* 1988; Saha *et al.* 1992; Rahman, 2003, but information during summer and hot humid condition is meager. Considering the above facts the present study was undertaken to determine the general combining ability (GCA) of the selected parents and specific combining ability (SCA) of the crosses and to know the combining ability of the parents for plant and flowering characters.

Materials and Methods

The present study was carried out at the experimental field of BSMRAU, Gazipur, Bangladesh during March 2007 to September 2008. Eight parents and 28 F_1 hybrids produced from those parents were used as plant materials for the study. The salient features of the selected genotypes are presented in Table 1. The selected eight parental genotypes were grown during summer 2007 for crossing in a half diallel fashion. For effective pollination and fertilization, the flower buds which just changed their color from green to purplish white and about to bloom next day were selected. Emasculation and pollination were done in the same day from 7.30-11.00 a.m. The pollinated flowers were bagged with butter paper and tagged along with necessary information. After complete maturity, some mature fruits from eight selfed parents and 28 F_1 crosses were harvested for obtaining the parental and F_1 hybrid seeds. Then the seeds

***Corresponding author: M S Uddin,** Dept. of Agroforestry and Environmental Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh, E-mail: mdsharafuddin@yahoo.com; sharaf.aes@sau.ac.bd*

of parents and F_1s were collected, air dried and preserved in desiccators with proper label and used for the study in the next season. Seeds of the selected parents and F_1 hybrids were sown on 14 March 2008 and after necessary hardening the seedlings were transplanted in the main field on 20 April 2008. The experiment was laid out in a randomized complete block design with 3 replications. Ten seedlings were planted in a unit plot with a plant spacing of 70 cm apart in single row maintaining 50 cm drain between the plots. Twenty eight F_1 hybrids along with their selected eight parental lines were grown for studying the combining ability. Observations were made on plant height, plant canopy, days to 1st flowering, days to 50% flowering, days to 1st fruit harvesting. The collected data were subjected to combining ability analysis following Model I and Method 2 (half diallel fashion) of Griffing (1956a). Griffing's analysis (Griffing, 1956b) was intended to determine the performance of the parents and their relative contribution to the F_1's as determined by general and specific combining ability (GCA and SCA) effects. The calculation of combining ability was performed from the following formula:

$Xijk = \mu+gi+gj+sij+eijk$; where, Xijk is the genotype score, μ is the overall mean of the experiment, so that all other scores are expressed as deviations from this mean, gi is the GCA effects of the ith parent, g_j is the GCA effects of the jth parent, sij SCA of the hybrid, eijk is the error deviation of the particular plot.

For the calculation of GCA of the parents and SCA of the hybrids, the mean was calculated over blocks and GCA and SCA were estimated from the means. Each column (or row) represented entries with one parent in common and crossed to all other parents including self. The column was referred to as an array. The GCA of any parent was estimated as the difference between its array mean and the overall mean.

Similarly, SCAs of the hybrids was also calculated as: $Sij= X-(\mu+gi+gj)$; where, X is the score of the hybrid between the ith and jth parents and the other terms are defined as above.

Table 1. Plant and flowering characters of eight selected parental eggplant genotypes during summer

Genotype	Identity	Place of collection	Parent symbol	Main features/Characteristics
SM001	BARI Begun-4 (Kazla)	HRC, BARI	P_1	Plant height is medium with prostrate growth habit and moderately spreading purplish look. Flower light violet color with early flowering habit. Fruit position on the plant is pendant.
SM002	Bottle	Tangail	P_2	Plant is medium height with prostrate growth habit and moderately spreading purplish look. Flower light violet color. Fruit position on the plant is pendant.
SM004	BARI Begun-6	HRC, BARI	P_3	Plant height is medium with intermediate growth habit and moderately spreading with purplish green look. Flower bluish violet color. Fruit position on the plant is semi-pendant.
SM006	BARI Begun-8	HRC, BARI	P_4	Plant height is high with intermediate growth habit and moderately spreading greenish purplish look. Flower bluish violet color. Fruit position on the plant is pendant.
SM024	D 68	PGRC, BARI	P_5	Plant growth habit is upright in nature. Plant is high with moderately spreading with light green look. Flower bluish violet color. Fruit position on the plant is semi-pendant.
SM034	D 79	PGRC, BARI	P_6	Plant growth habit is intermediate in nature. Plant is high with moderately spreading with light green look. Flower bluish violet color. Fruit position on the plant is pendant.
SM057	BD2840	PGRC, BARI	P_7	Plant growth habit is prostrate in nature. Plant is dwarf with low spreading purplish look. Flower bluish violet color. Fruit position on the plant is pendant.
SM067	Satkhira Local	Jessore	P_8	Plant growth habit is intermediate in nature. Plant is medium high with moderately spreading light green look. Flower bluish violet color. Fruit position on the plant is semi-pendant. Very few to few prickles presence on both calyx and pedicel of both flower and fruit.

Results and Discussion

Plant height

For plant height the highest positive and significant GCA effect was exposed by P_4 (14.52**) followed by P_5 (13.10**), P_6 (6.80**) and P_3 (4.22**). On the contrary, the significant negative GCA effect was showing by other genotypes P_2 (-15.34**), P_7 (-13.31**), P_1 (-6.19**) and P_8 (-3.80**) (Table 2). Therefore, the parent P_4 was the

best general combiner for plant height in eggplant. Good general combining ability for plant height was also reported by Singh *et al.* (1991) and Rahman (2003).

The highest significant positive SCA effect was uncovered by the cross $P_5 \times P_6$ (16.03), followed by $P_1 \times P_2$ (15.56), $P_6 \times P_8$ (15.33), $P_6 \times P_7$ (13.44), $P_3 \times P_8$ (12.11), $P_3 \times P_7$ (10.92) indicated the heterotic performance of plant height over the mean of their parents. Conversely, the highest negative significant SCA effects was exposed by the cross combinations $P_1 \times P_6$ (-29.08) followed by $P_2 \times P_5$ (-12.23) and $P_2 \times P_6$ (-9.73) indicated the decreasing of plant height over the mean of their parents (Table 2). Ingale and Patil (1997), Saha *et al.* (1992) and Rahman (2003) also reported hybrid performance in plant height in some crosses of eggplant.

Table 2. Estimates of combining ability effects for plant height in eggplant during summer

Parents	SCA							GCA
	P_2	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	
P_1	15.66**	-4.80*	3.00	9.42*	-29.08**	2.63	3.32	-6.19**
P_2		1.05	6.15*	-12.23**	-9.73**	5.38*	2.07	-15.34**
P_3			7.19*	0.01	0.91	10.92**	12.11**	4.22**
P_4				-2.69	8.01*	5.12*	6.61*	14.52**
P_5					16.03**	6.54*	4.63*	13.10**
P_6						13.44**	15.33**	6.80**
P_7							6.04*	-13.31**
P_8								-3.80**
SE (Sij)				3.61				
SE (Gi)								1.35
CD (.05)				3.72				2.28
CD (.01)				9.45				3.54

** Significant at 5% and ** Significant at 1% level of probability*

East-west plant canopy

Among the parents the highest positive and significant GCA effect was found in P_6 (6.92) for east-west plant canopy followed by P_4 (6.30) and P_3 (4.84). On the other hand, the significant negative GCA effect was exposed by P_7, P_2 and P_5. Therefore, the parent P_6 was the best general combiner for east-west plant canopy in eggplant (Table 3). Good general combining ability for east-west plant canopy was also reported by Singh *et al.* (1991).

The highest significant positive SCA effect was shown by the cross $P_1 \times P_8$ (22.05) followed by $P_4 \times P_7$ (19.35), $P_4 \times P_6$ (19.05), $P_3 \times P_8$ (18.29), $P_5 \times P_7$ (16.75) for east-west plant canopy in eggplant representing the heterotic performance of east-west plant canopy over the mean of their parents (Table 3). Conversely, the highest negative significant SCA effect was exposed by the cross combinations $P_3 \times P_4$ (-21.67) followed by $P_2 \times P_6$ (-20.05), $P_2 \times P_8$ (-13.67), $P_1 \times P_6$ (-13.33) $P_1 \times P_7$ (–10.43), $P_7 \times P_8$ (-8.69) representing the decreasing of east-west plant canopy over the mean of their parents.

Table 3. Estimates of combining ability effects for east-west plant canopy in eggplant during summer

Parents	SCA							GCA
	P_2	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	
P_1	-1.01	-1.05	7.29*	1.89	-13.33*	-10.43*	22.05**	2.68
P_2		1.63	13.17*	7.77*	-20.05**	8.05*	-13.67*	-7.40**
P_3			-21.67**	-5.27*	1.91	5.81*	18.29**	4.84*
P_4				-0.53	19.05**	19.35**	9.63*	6.30**
P_5					-0.15	16.75**	5.43*	-3.3*
P_6						13.53*	4.21	6.92**
P_7							-8.69*	-10.18**
P_8								0.14
SE (Sij)				5.97				
SE (Gi)								2.23
CD (.05)				4.79				2.93
CD (.01)				15.64				5.86

** Significant at 5% and ** Significant at 1% level of probability*

North- south plant canopy

Among the parents the highest positive and significant GCA effect was observed in P_4 (10.89) followed by P_3 (7.24) and P_6 (3.93) for north-south plant canopy in eggplant. Nevertheless, the significant negative GCA effect was found

in other genotypes (Table 4). Therefore, the parent P_4 was the best general combiner for north-south plant canopy in eggplant. Good general combining ability for north-south plant canopy was also reported by Singh *et al*. (1991).

The highest significant positive SCA effect was exposed by the cross $P_3 \times P_8$ (20.73) followed by $P_5 \times P_7$ (19.99), $P_2 \times P_7$ (19.41) for north-south plant canopy representing the heterotic performance of north-south plant canopy over the mean of their parents. On the contrary, the highest negative significant SCA effects was exposed by the cross combinations $P_7 \times P_8$ (-16.23) followed by $P_2 \times P_6$ (-11.52) and $P_1 \times P_5$ (-10.10) representing the decreasing of north-south plant canopy over the mean of their parents (Table 4). Ingale and Patil (1997) also reported hybrid performance for north-south plant canopy in some crosses of eggplant.

Table 4. Estimates of combining ability effects for north-south plant canopy in eggplant during summer

Parents	SCA							GCA
	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
P_1	1.52	-3.05	-1.30	-10.10*	2.46	5.19*	11.48*	1.49
P_2		-0.23	12.12*	5.32*	-11.52*	19.41**	3.5	-7.93**
P_3			-15.05*	6.15*	2.91	-4.66	20.73**	7.24**
P_4				-11.30*	3.26	15.59*	6.08*	10.89**
P_5					1.86	19.99**	2.28	-2.31
P_6						2.55	8.04*	3.93*
P_7							-16.23**	-13.40**
P_8								0.11
SE (Sij)				5.98				
SE (Gi)								2.24
CD (.05)				4.79				2.93
CD (.01)				15.65				5.87

** Significant at 5% and ** Significant at 1% level of probability*

Days to first flower

The estimate of GCA effects of eight parents for days to first flowering is given in Table 5 which shows that among the parents the highest positive and significant GCA effect was found in P_3 (3.37**) followed by P_4 (0.95**). On the other hand, P_1 showed the highest significant negative GCA effect (-2.84**) followed by P_5 (-1.38**) and P_6 (-0.44**). Therefore, the parent P_1, P_5 and P_6 were better general combiner for promoting early flowering in eggplant. Saha *et al.* (1992) and Kumar *et al.* (1996) also reported some good general combiners for early flowering in eggplant.

The highest significant positive SCA effect was provided by the cross $P_1 \times P_6$ (6.10**) followed by $P_1 \times P_4$ (5.72**), $P_1 \times P_8$ (5.42**), $P_3 \times P_8$ (5.22**), $P_1 \times P_7$ (4.61**), $P_2 \times P_5$ (4.17**). While, the highest negative significant SCA effects was observed in $P_2 \times P_3$ (-5.67**) followed by P_1 x P_5 (-5.16**), $P_3 \times P_5$ (-4.16**), $P_3 \times P_6$ (-4.10**), $P_3 \times P_7$ (-3.69**), $P_4 \times P_8$ (-3.36**), $P_4 \times P_6$ (-2.68**), $P_2 \times P_8$ (-2.45**), $P_6 \times P_7$ (-1.59**) and $P_5 \times P_7$ (-0.85**) (Table 5). Saha *et al*. (1992) and Rahman (2003) also reported earliness in some crosses in eggplant.

Days to 50% flowering

The estimate of GCA effects of eight parents for days to 50% flowering is given in Table 6. Among the parents the highest positive and significant GCA effect was shown by P_3 (1.23**) followed by P_4 (0.91**) and P_7 (0.57**). On the other hand P_1 showed the highest significant negative GCA effect (-1.67**) followed by P_5 (-0.43**) and P_8 (-0.29*). Therefore, the parent P_1 and P_5 were the best general combiner for promoting early flowering in eggplant. Kumar *et al.* (1996) and Rahman (2003) also reported some good general combiners for early flowering in eggplant.

The highest significant positive SCA effect was exposed by the cross $P_2 \times P_6$ (2.78**) followed by $P_1 \times P_7$ (2.56**), $P_1 \times P_8$ (2.42**), $P_1 \times P_6$ (2.24**), $P_2 \times P_5$ (2.10**), $P_2 \times P_7$ (2.10**), $P_4 \times P_5$ (1.98**), $P_2 \times P_4$ (1.76**). On the other hand, the highest negative significant SCA effects was exposed by the cross combination $P_1 \times P_4$ (-3.78**) followed by $P_2 \times P_3$ (-3.76**), $P_6 \times P_8$ (-2.14**), $P_2 \times P_8$ (-2.04**), $P_1 \times P_5$ (-1.84**), $P_5 \times P_8$ (-1.82**), $P_5 \times P_7$ (-1.68**), $P_4 \times P_6$ (-1.34**) and $P_6 \times P_7$ (-1.20**) (Table 6). Rahman (2003) also reported earliness in some crosses in eggplant.

Days to first harvest

The estimate of GCA effects of eight parents for days to first harvest presented in Table 7. Among the parents the highest positive and significant GCA effect was provided by P_3 (5.25**) followed by P_7 (0.45**). Whilst, P_8 (-2.05**) showed the highest significant negative GCA effect followed by P_1 (-1.35**), P_4 (-1.35**), P_6 (-0.65**) and P_5 (-

0.25**). Therefore, the parent P_8, P_1, P_4 and P_6 were the best general combiner for promoting early harvest in eggplant. Rahman (2003) and Rai *et al.* (2005) also reported some good general combiners for early harvest in eggplant.

Table 5. Estimates of combining ability effects for days to 1st flowering in eggplant during summer

Parents	SCA							GCA
	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
P_1	2.63**	1.70**	5.72**	-5.16**	6.10**	4.61**	5.42**	-2.84**
P_2		-5.67**	2.85**	4.17**	2.23**	2.74**	-2.45**	0.04
P_3			0.52	-4.16**	-4.10**	-3.69**	5.22**	3.37**
P_4				1.26**	-2.68**	1.83**	-3.36**	0.95**
P_5					2.64**	-0.85**	-1.04**	-1.38**
P_6						-1.59**	0.02	-0.44**
P_7							-0.47	0.06
P_8								0.25*
SE (Sij)				0.30				
SE (Gi)								0.11
CD (.05)				0.60				0.23
CD (.01)				0.79				0.30

** Significant at 5% and ** Significant at 1% level of probability*

Table 6. Estimates of combining ability effects for days to 50% flowering in eggplant during summer

Parents	SCA							GCA
	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
P_1	1.34**	1.50**	-3.78**	-1.84**	2.24**	2.56**	2.42**	-1.67**
P_2		-3.76**	1.76**	2.10**	2.78**	2.10**	-2.04**	-0.21
P_3			0.32	-0.34	-0.66*	-0.54	-0.48	1.23**
P_4				1.98**	-1.34**	-0.02	-0.16	0.91**
P_5					1.00**	-1.68**	-1.82**	-0.43**
P_6						-1.20**	-2.14**	-0.11
P_7							0.18	0.57**
P_8								-0.29*
SE (Sij)				0.30				
SE (Gi)								0.11
CD (.05)				0.58				0.22
CD (.01)				0.77				0.29

** Significant at 5% and ** Significant at 1% level of probability*

The highest significant positive SCA effect was uncovered by the cross $P_7 \times P_8$ (8.66**) followed by $P_1 \times P_4$ (6.76**), $P_1 \times P_5$ (5.66**) and $P_1 \times P_3$ (3.16**) for days to 1st harvest. Conversely, the highest negative significant SCA effects was exposed by the cross combination $P_5 \times P_8$ (-7.64**) followed by $P_1 \times P_8$ (-6.54**), $P_3 \times P_5$ (-5.94**), $P_3 \times P_4$ (-4.84**), $P_4 \times P_8$ (-4.54**), $P_4 \times P_6$ (-1.94**), $P_3 \times P_7$ (-1.64**), $P_2 \times P_7$ (-1.34**), $P_5 \times P_7$ (-1.14**), $P_6 \times P_7$ (-0.74**) (Table 7). Pan *et al*. (1996) and Rahman (2003) also reported earliness in some crosses in eggplant.

Table 7. Estimates of combining ability effects for days to 1st harvest in eggplant during summer

Parents	SCA							GCA
	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
P_1	0.46	3.16**	6.76**	5.66**	1.06**	-0.04	-6.54**	-1.35**
P_2		1.86**	0.46	-0.64*	-0.24	-1.34**	1.16**	-0.05
P_3			-4.84**	-5.94**	-0.54*	-1.64**	0.86**	5.25**
P_4				0.66**	-1.94**	-0.04	-4.54**	-1.35**
P_5					-0.04	-1.14**	-7.64**	-0.25**
P_6						-0.74**	1.76**	-0.65**
P_7							8.66**	0.45**
P_8								-2.05**
SE (Sij)				0.24				
SE (Gi)								0.09
CD (.05)				0.48				0.18
CD (.01)				0.64				0.24

** Significant at 5% and ** Significant at 1% level of probability*

Considering general combining ability effects, the parents P_3, P_4 and P_6 were the good general combiner for plant height and canopy and P_3, P_4, and P_7 for early flowering and fruiting. Considering specific combining ability effects,

the cross $P_3 \times P_8$ was important for plant height and canopy, $P_5 \times P_7$ for plant canopy; $P_1 \times P_6$, $P_1 \times P_4$, $P_1 \times P_8$ and $P_1 \times P_7$ were important for early flowering and fruiting. For improvement of flowering and plant characters the parents P_3, P_4, and P_7 and the crosses $P_1 \times P_6$, $P_1 \times P_4$, $P_1 \times P_8$ and $P_1 \times P_7$ could be selected for summer season cultivation in Bangladesh.

References

Griffing B. 1956a. A generalized treatment of the use of diallel cross in quantitative inheritance. Heredity. 10:13-50.

Griffing B. 1956b. Concepts of general and specific combining ability in relation to diallel crossing systems. Australian J. Biol. Sci. 9:463-493.

Ingale B V and Patil S J. 1997. Heterosis breeding in brinjal (*Solanum melongena* L.). PKV Res. J. 21(1):25-29.

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

Pan X Q, Wang H C and Liu J S. 1996. New eggplant F1 hybrid 'Jiqie'. China Vegetables. 6:1-3.

Rahman M A. 2003. Heterosis in eggplant. M. S. Thesis. Department of Horticulture, BSMRAU, Gazipur, Bangladesh. 108p.

Rai N, Yadav D S, Patel K K and Yadav R K. 2005. Genetics of earliness in brinjal (*Solanum melongena* L.). Veg. Sci. 32(1): 44-46.

Rashid M A, Mondol S N, Ahmed M S, Ahmed S and Sen D K. 1988. Genetic Variability, combining ability estimates and hybrid vigor in eggplant (*Solalanum melongena* L.) Thai. J. Agric. Sci. 21:51-61.

Saha M G, Sharifuzzaman S M, Bhawmik A, Hoque K R and Hossain A K M A. 1992. Genetic analysis of flowering time in brinjal (*Solanum melongena* L.). Bangladesh Hort. 20(1):35-39.

Singh B and Kumar N. 1988. Studies on hybrid vigor and combining ability in brinjal (*Solanum melongena* L.). Veg. Sci. 15(1):72-78.

Singh D P, Prasad V S R K and Singh R P. 1991. Combining ability in eggplant. Indian J. Hort. 48(1):52-57.