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Basant Kachouli
Department of Plant Breeding and Genetics, College of Horticulture, Rajmata Vijayaraje Scindia Krishi VishvaVidyalay, Madhya Pradesh, India

AK Singh
Department of Plant Breeding and Genetics, RVSKVV, Gwalior, Madhya Pradesh, India

SK Jatav
Krishi Vigyan Kendra, Badgaon, Balaghat, JNKVV Jabalpur, Madhya Pradesh, India

SS Kushwah
Department of Vegetable Science, College of Horticulture Rajmata Vijayaraje Scindia Krishi VishvaVidyalay, Madhya Pradesh, India

Correspondence
Basant Kachouli
Department of Plant Breeding and Genetics, College of Horticulture, Rajmata Vijayaraje Scindia Krishi VishvaVidyalay, Madhya Pradesh, India

Combining ability analysis for yield and yield attributes characters in Brinjal (*Solanum melongena* L.)

Basant Kachouli, AK Singh, SK Jatav and SS Kushwah

Abstract
Combining ability analysis was done in dialle analysis by using 8 parents and 28 F_1's in a randomized block design with two replications. Analysis of variance for combining ability revealed that variances due to gca and sca were significant for all the traits. GCA and SCA interacted significantly. The estimates of dominance variance were higher in magnitude than corresponding estimates of additive variance indicating the preponderance of non-additive gene action. None of the parents exhibited desirable gca effects for all the traits simultaneously. Parents DRNKVO-2-26 identified as good general combiners for fruit yield per plant and most of the attributes including seed weight per fruit, average fruit weight and fruit length. The cross, DRNKVO-2-26 x JB-15, Arbha Kranti X Rajendra brinjal, and Aruna X DRNKVO-2-26 were good specific combiner for grain yield and various yield components. These parents may be used for varietal improvement through the simple recurrent selection in segregating generations to increase in fruit yield potentiall of brinjal. This may lead in the fixation of both additive and non-additive components while making improvement in fruit yield and its attributes.

Keywords: Combining ability, GCA, SCA, Diallel

Introduction

Brinjal (*Solanum melongena* L) is the very important vegetable crop cultivating in India Sękara *et al.* (2007) [14]. Brinjal is often cross pollinated and possess considerable diversity for plant types, fruit yield and yield attributing characters and thus offers an opportunity to exploit the genetic diversity for development of hybrid varieties. In most of the countries, brinjal is the major component of the human diet. It is rich source of protein, P, Fe, Ca, K, Mg, Na and fibre Nyadanu and Lowor, (2015) [10]. It has medicinal value for asthma, allergic rhinitis, constipation, skin infections, joint pains, dyspepsia and rheumatic diseases Nwodo *et al.* (2011) [9].

The combining ability analysis is an important tool in preferring suitable parents for hybridization and superior cross combinations through general combining ability (GCA) and specific combining ability (SCA), respectively Sharma *et al.* (2016) [16]. In the present investigation, a study was conducted to study the combining ability analysis in various crosses.

Methods and Materials

The present experiment was conducted at Bahadari Farm, College of Horticulture Mandsaur Madhya Pradesh India. An experiment was sown in randomized complete block design with 2 replications. The experimental materials for the present study comprised of eight elite genotypes viz., Arka kranti, Kashi taru long, Aruna, HABR-4 (Swarna Shobha), JB-64, DRNKVO-2-26, Rajendra brinjal and JB-15, were crossed in half diallel technique, in all possible combinations excluding reciprocals and generated a set of 28 F_1 hybrids. Crosses were made Kharif 2015 for the evaluation of F_1s during two seasons's viz., 2016 and 2016-17. Three dates of sowing seedlings were transplanted at the spacing of 60 cm x 50 cm in rows of 5 meter length consisting of 10 plants each row. Recommended package of practices were followed for raising the normal seedlings and crop. Observations were recorded on five randomly selected plants from each hybrid in each replication. Observations were recorded on five randomly selected plants in each parents and cross for grain yield and its attributes (Table 1). The data were subjected to appropriate statistical analysis. The combining ability analysis was carried out according to Griffing's (1956) [5] Method 2 Models I (fixed effect). In this approach, using a suitable statistical model the component of variances due to general and specific combining ability was estimated.

Results and Discussion

Analysis of variances for combining ability

The analysis of variances of combining ability was done for all ten characters for both the years, separately and results are presented in Table 1. The mean sum of squares was partitioned into three parts viz. mean squares due to gca, sca and error. The result revealed that the general combining ability (gca) and specific combining ability (sca) mean squares were highly significant for all the characters in pooled analysis. These results revealed importance of additive as well as non-additive components in the inheritance of fruit yield and yield components. Significance of general combing ability and specific combing ability variances were also reported earlier for yield and yield components by Yadav *et al.* (2017) [21] and Dubey *et al.* (2014) [4].

General combining ability effects of the parents

The vital choice of parents to be used in a breeding programme is determined by *per se* performance and their behavior in hybrid combination. Out of eight parents, the parents Kashi Taru (4.88) and JB (1.13) were identified good general combiners for maximum plant height (Table 2). Similar results were also expressed by Mishra *et al.* (2013) [8]. Arbha kranti, HABR 4 and JB 15 were found good combiners as the parent's significant positive effects for pooled analysis (Table 1).Thus additive gene action does not play any role for improvement for this character. These results are in agreement with the reports of Das and Baruha (2001) [2] and Singh *et al.* (2002) [17] who found significant gca effects for number of branches per plant.

HABR-4 and Aruna were found good general combiners as these parents had significant negative gca effects for earliness traits i.e., days to first flowering and days to first picking. The similar results was also reported earlier by Dharwad *et al.* (2011) [3] for days to first flowering. Parents Kashi Taru (2.99), DRNKVO-2-26 (1.73) and Rajendra Brinjal (1.55) were recognized as significant positive general combining ability effects for fruit length. However, for fruit girth, parents Aruna (3.63), HABR-4 (3.60) and Arbha kranti (2.14) were established good general combiners. Uddin *et al.* (2015) [19] also reported the gca effects for fruit length and girth. For fruit yield per plant, significant positive gca effect was observed in DRNKVO-2-26(0.55) showing the good general combiners. Arbha kranti (1.62), HABRA-4 (0.88) and DRNKVO-2-26 (0.84) were good general combiner for seed weight per fruit. The best general combiners for average fruit weight recorded in HABRA-4 (33.95) followed by DRNKVO-2-26 (22.68) and Aruna (12.58). Similar findings also reported by Reddy and Patel (2014) [13] and Singh and Chaudhary (2018) [18]. Rajendra Brinjal (5.87) and Aruna (0.27) was identified as it had significant positive gca effects for Ascorbic acid content. The gca variances revealed the predominance of additive gene action over additive gene action in controlling ascorbic acid content in fruits, as contrasting results were reported by Kumar *et al.* (2013) [7] and Patel *et al.* (2017) [12]. DRNKVO-2-26 also found good general combiner for quality parameters including fruit yield per plant, fruit length, seed weight per fruit and average fruit weight.

Specific combining ability effects of the hybrids

Magnitudes of sca effects in the hybrids were in low x low, high x low, average x low average x high and high x high for all the characters (Table 3). For plant height, Aruna X JB-4 (0.36),Kashi Taru X JB-64 (0.57), and Arbha kranti X Aruna (0.69) showed significant specific combining ability effects. The findings for plant height were also in accordance with Suneetha *et al.* (2008) [15] (Table 3). HABRA-4 X DRNKVO-2-26 (0.12), Arbha kranti X JB-15 (0.13) and Arbha kranti X Kashi Taru (0.17) the high significant sca effects for number of branches per plant. For days to first flowering and days to first pickingDRNKVO-2-26 X JB-15 (-0.41) and HABR-4 X JB-15 (2.56) were sca effects with positive significant value. For Fruit length, Arbha Kranti X Aruna, Kashi taru X Aruna, DRNKVO-2-26 X JB-15 found significant high sca effects. However for fruit grith, ArbhaKranti X HABR-4 and Arbha Kranti X JB-64 showed high sca effects with positive significant value. The similar results were also reported earlier by Singh *et al.* (2002) [17], Venkatesan (2007) [20] and Pachiyappan *et al.* (2012) [11]. The high sca effects for fruit yield per plant were found in the hybrids DRNKVO-2-26 x JB-15, Arbha Kranti X Rajendra brinjal, and Aruna X DRNKVO-2-26. Arbha Kranti X HABR-4, Arbha Kranti X JB-64 and Arbha Kranti x DRNKVO-2-26 established the significant sca effects for seed weight per fruit.For average fruit weight, KashiTaru X DRNKVO-2-26,Arbhakranti X JB-64 and HABR -4 xJB-64 were found significant high sca effects. Among the hybrids, Aruna x Rajendra brinjal, HABR-4 X DRNKVO-2-26 and Arunax DRNKVO-2-26were observed high sca effects for Ascrbic acid content.The similar results were also reported earlier by Ansari and Singh (2014) [1] and Hussain *et al.* (2017) [6].

Analysis of combining ability in the present brinjal material suggested an idea about breeding methodology to be applied and use of promising crosses for further improvement in brinjal. In self –pollinated crops like brinjal, SCA effects are not much important as they are mostly related to non-additive gene effects excluding those of arising from complementary gene action or linkage effects they cannot be fixed in lines. Further superiority of the hybrids might not indicate their ability to yield transgressive segregates; rather SCA would provide satisfactory criteria and expected to throw desirable transgressive segregates in later generations. Fruit yield and major yield components revealed the significance of both additive and non-additive gene action for fruit yield and its different components.

Table 1: Pooled Analysis of variance for general and specific combining ability for various characters in Brinjal

Source of variation	df	Plant height	No. of Branches/ plant	Days to first flowering	Days to first picking	Fruit length	Fruit girth	Fruit yield per plant	Seed weight / fruit	Average fruit weight	Ascorbic acid content
Parents	7	288.77**	13.37**	187.63**	358.42**	197.12**	460.30**	1.57**	47.16**	26075.21**	294.68**
Hybrids	27	103.40**	5.64**	34.53**	39.64**	82.22**	173.80**	1.25**	18.99**	9665.44**	119.08**
Error	210	0.20	0.03	0.30	0.31	0.08	0.05	0.00	0.02	0.98	0.04

Table 2: Pooled analysis of general combining ability effects for various traits in brinjal

Parents		Plant height	No. of branches per plant	Days to first flowering	Days to first picking	Fruit length	Fruit girth	Fruit yield per plant	Seed weight / fruit	Average fruit weight	Ascorbic acid content
P1	Arbha Kranti	-0.17**	0.25**	1.10**	0.42**	-0.57**	2.14**	-0.13**	1.62**	-3.01**	-1.71**
P2	Kashi Taru	4.88**	-0.05**	-0.77**	-0.74**	2.99**	0.75**	-0.07**	-0.63**	-2.79**	-1.21**
P3	Aruna	-0.13**	-0.06**	-0.87**	-1.19**	-2.24**	3.63**	-0.02**	-0.66**	12.58**	0.27**
P4	HABR-4	0.01	0.19**	-2.78**	-2.08**	-0.07**	3.60**	-0.09**	0.88**	33.95**	-0.60**
P5	JB-64	-1.80**	-0.48**	1.25**	-1.58**	-3.17**	-3.89**	-0.03**	-0.90**	-38.69**	-0.25**
P6	DRNKVO-2-26	-2.24**	-0.86**	0.78**	1.07**	1.73**	-3.49**	0.55**	0.84**	22.68**	-2.08**
P7	Rajendra Brinjal	-1.68**	0.95	0.82**	3.28**	1.55**	-2.60**	-0.06**	-0.08**	-13.16**	5.87**
P8	JB-15	1.13**	0.07**	0.46**	0.83**	-0.22**	-0.15**	-0.15**	-1.06**	-11.57**	-0.29**
S.E.gi		0.04	0.01	0.05	0.05	0.07	0.02	0.00	0.01	0.08	0.02
S.E.gi-gj		0.06	0.02	0.07	0.07	0.09	0.03	0.01	0.02	0.13	0.03

*, ** Significant at 5 and 1 % levels, respectively

Table 3: Pooled analysis of specific combining ability effects for various traits in Brinjal

Crosses		Plant height	No. of branches per plant	Days to first flowering	Days to first picking	Fruit length	Fruit girth	Fruit yield per plant	Seed weight / fruit	Average fruit weight	Ascorbic acid content
C1 (P1×P2)	Arbha Kranti * Kashi Taru	-0.95**	0.17**	0.35*	1.24**	0.09	-0.54**	-0.12**	-0.24**	-1.00**	-0.16**
C2 (P1× P3)	Arbha Kranti * Aruna	0.69**	-0.08	2.34**	0.07	0.17*	0.42**	0.01	-0.13**	0.54*	-0.13*
C3 (P1× P4)	Arbha Kranti * HABR-4	2.69**	0.39**	1.13**	0.46**	0.45**	0.31**	0.04**	0.15**	3.74**	-0.21**
C4 (P1× P5)	Arbha Kranti * JB-64	1.27**	0.02	1.69**	2.90**	0.03	0.40**	-0.01	0.09*	0.76**	0.04
C5 (P1× P6)	Arbha Kranti * DRNKVO-2-26	0.48**	0.29**	-0.28*	1.36**	-0.16*	0.08	0.04**	0.20**	-0.54*	0.56**
C6 (P1× P7)	Arbha Kranti * Rajendra Brinjal	0.54**	-0.38**	1.08**	0.12	0.07	-0.08	0.09**	0.12**	0.09	0.44**
C7 (P1× P8)	Arbha Kranti * JB-15	0.18	0.13**	0.37**	0.11	0.13	0.21**	0.02	0.12**	0.90**	-0.05
C8 (P2× P3)	Kashi Taru * Aruna	-1.21**	0.06	0.00	0.58**	-0.26**	-0.25**	0.00	-0.02	-0.11	-0.10*
C9 (P2× P4)	Kashi Taru * HABR-4	3.91**	0.23**	2.88**	2.82**	0.07	0.30**	0.02	0.14**	1.70**	0.56**
C10 (P2× P5)	KashiTaru * JB-64	0.57**	-0.04	1.11**	2.20**	-0.39**	0.06	0.04**	0.30**	-1.13**	-0.10*
C11 (P2× P6)	Kashi Taru * DRNKVO-2-26	0.60**	0.05	0.73**	0.60**	0.78**	0.18**	0.06**	-0.10**	0.11	-0.07
C12 (P2× P7)	Kashi Taru * Rajendra Brinjal	-0.39**	0.12**	0.79**	1.06**	0.24**	-0.14*	-0.01	-0.11**	-0.30	-0.07
C13 (P2× P8)	Kashi Taru * JB-15	0.29*	0.02	2.39**	-1.53**	-0.34**	0.14*	0.05**	0.09*	2.54**	-0.06
C14 (P3× P4)	Aruna * HABR-4	1.73**	0.04	0.48**	2.19**	-0.19**	0.20**	-0.01	0.12**	0.23	-0.06
C15 (P3× P5)	Aruna * JB-64	0.36**	0.00	2.69**	2.32**	-0.08	-0.44**	-0.02	-0.05	-0.88**	-0.02
C16 (P3× P6)	Aruna * DRNKVO-2-26	0.21	-0.03	1.02**	1.34**	-0.18*	-0.36**	0.13**	0.16**	-0.18	0.21**
C17 (P3× P7)	Aruna * Rajendra Brinjal	0.35**	0.10*	1.47**	-1.80**	0.08	-0.32**	0.03*	-0.23**	-0.78**	0.54**
C18 (P3× P8)	Aruna * JB-15	0.18	0.07	-0.45**	1.23**	0.17*	0.43**	-0.01	0.55**	2.24**	-0.04
C19 (P4× P5)	HABR-4 * JB-64	0.37**	0.07	3.93**	3.25**	0.44**	-0.04	-0.02	0.04	1.28**	0.33**
C20 (P4× P6)	HABR-4 * DRNKVO-2-26	1.32**	0.12**	1.17**	-0.64**	0.36**	0.36**	0.14**	0.05	0.89**	0.12*
C21 (P4× P7)	HABR-4 * Rajendra Brinjal	0.85**	0.26**	1.60**	2.31**	0.35**	0.16**	-0.08**	0.19**	1.30**	-0.27**
C22(P4× P8)	HABR-4 * JB-15	-0.66**	-0.18**	2.56**	1.18**	0.15*	-1.74**	0.01	-0.65**	-19.82**	-0.09
C23 (P5× P6)	JB-64 * DRNKVO-2-26	-0.01	-0.04	1.57**	1.39**	-0.15*	0.14*	0.09**	0.06	-0.36	-0.01
C24 (P5× P7)	JB-64 * Rajendra Brinjal	0.27*	0.04	1.06**	1.12**	0.03	-0.18**	-0.02	-0.07*	-0.87**	-0.17**
C25 (P5× P8)	JB-64 * JB-15	0.56**	-0.05	0.84**	1.62**	0.35**	0.15*	-0.01	-0.03	2.16**	-0.01
C26 (P6× P7)	DRNKVO-2-26*Rajendra Brinjal	0.75**	0.05	-0.33*	-0.85**	0.11	-0.15*	0.08**	0.04	-0.39	-0.25**
C27 (P6× P8)	DRNKVO-2-26 * JB-15	1.11**	0.00	-0.41**	-1.03**	-0.10	0.16*	0.09**	0.13**	2.31**	-0.04
C28 (P7× P8)	Rajendra Brinjal * JB-15	1.22**	0.08	0.53**	0.89**	-0.05	0.84**	0.00	0.08*	2.00**	0.43**
S.E.(Sij)		0.10	0.04	0.12	0.13	0.06	0.05	0.01	0.03	0.23	0.04
S.E.(Sij-Sik)		0.17	0.06	0.21	0.22	0.11	0.10	0.02	0.05	0.38	0.08

*, ** Significant at 5 and 1 % levels, respective

Reference

1. Ansari AM, Singh YV. Combining ability analysis for vegetative, physiological and yield components in brinjal (*Solanum melongena* L.). International Science Journal. 2014; 1(2):53-59.
2. Das G, Barua NS. Heterosis and combining ability for yield and its components in brinjal. Annals of Agri. Res.2001; 22(3):399-403.
3. Dharwad NA, Patil SA, Salimath PM. Heterosis and combining ability analysis for productivity traits in brinjal (*Solanum melongena* L.). Karnataka Journal of Agriculture Sciences. 2011; 24(5):622-625.
4. Dubey R, Arpita Das, Ojha MD, Shah B, Ranjan A, Singh P K. Heterosis and combining ability studies for yield and yield attributing traits in brinjal (*Solanum melongena* L.). The Bioscan 2014; 9(2):889-894.
5. Griffing B. Concept of general and specific combining ability in relation to diallel crossing system. Australian Journal of Biological Sciences.1956; 9:465-493.
6. Hussain K, SH Khan, Kouser Parveen MI, Mukhdoomi G, Nazir B, Afroza PK, Singh, Dar ZA. Combining Ability Analysisin Brinjal (*Solanum melongena* L.). Int. J. Curr. Microbiol. App. Sci. 2017; 6(7):1645-1655.
7. Kuma RS, Arumugam T, Anandakumar CR, Prema Lakhsmi V. Genetic variability for quantitative and qualitative characters in brinjal (*Solanum melongena* L.). African Journal of Agric Research. 2013; 8(39):4956-4959.
8. Mishra R, Singh AK, Manju Vani V, Singh BK, Kumar H, Rajkumar BV. Combining ability studies in elite breeding lines of brinjal (*Solanum melongena* L.) for plant characters. sian Journal of Biological and Life Sciences. 2013; 2(3):275-278.
9. Nwodo SC, Abayomi CO, Eboji OK, Opeyemi CE, Olajumoke AK, Damilola ID. Proximate and phytochemical analysis of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. fruits. Research Journal of Chemical Sciences. 2011; 1(3):436-439.
10. Nyadanu D, Lowor ST. Promoting competitiveness of neglected and underutilized crop species: Comparative analysis of nutritional composition of indigenous and

exotic leafy and fruit vegetables in Ghana. Genetic Resources and Crop Evolution. 2015; 62(1):131-140.
11. Pachiyappan R, Saravanan K, Kumar R. Heterosis in yield and yield components in eggplant. International Journal of Current Agricultural Sciences. 2012; 2(6):17-19.
12. Patel AA, Gohil DP, Patel NB, Patel DD. Combining ability and gene action studies in brinjal (*Solanum melongena* L.). Journal of Pharmacognosy and Phyto chemistry. 2017; 6(5):2137-2143.
13. Reddy EE. Patel AI. Heterosis Studies for Yield and Yield Attributing Characters in Brinjal (*Solanum melongena* L.). Trends in Biosciences. 2014; 7(3):377-380.
14. Sękara A, Cebula S, Kunicki E. Cultivated eggplants– origin, breeding objectives and genetic resources, a review. Folia Horticulturae. 2007; 19:97-114.
15. Suneetha Y, Kathiria KB, Patel JS, Sriniva T. Studies on heterosis and combining ability in late summer brinjal. Indian Journal of Agricultural Research. 2008; 42(3):171-176.
16. Sharma TK, Pant SC, Kumar S, Paliwal A, Bahuguna P, Badhani HC. Combining Ability Studies in Brinjal (*Solanum melongena* L.) International Journal of Bio-resource and Stress Management. 2016; 7 (6):1225-1231.
17. Singh HV, Singh SP, Singh M, Singh M. Genetic analysis of quantitative traits in brinjal (*Solanum melongena* L.). Vegetable Science. 2002; 29(1):84-86.
18. Singh AP, Vaibhav Chaudhary. Genetic Analysis for Yield and Yield Contributing Characters in Brinjal (*Solanum melongena* L.) Over Environments. Int. J. Curr. Microbiol. App. Sci. 2018; 7(08):1493-1504.
19. Uddin MS, Rahman MM, Hossain MM, Mian MAK. Combining ability of yield and yield components in Eggplant (*Solanum melongena* L.) during summer. Universal Journal of Plant Science. 2015; 3(4):59-66.
20. Venkatesan V. Studies on the genetic parameters through diallel analysis in brinjal (*Solanum melongena* L.). M.Sc. (Agri.) Thesis, Annamalai University, Chidambaram, 2007, 74-85.
21. Yadav PK, Dubey RK, Sanket Kumar, Yadav Ram, Maneesh Kumar Singh. Implications of Combining Ability among the Single Cross Hybrids for Yield and Quality Attributes in Brinjal (*Solanum melongena* L.). Int. J Curr. Microbiol. App. Sci. 2017; 6(10):3424-3429.