Vegetable Science (2011) 38(1) : 49-52

Combining ability studies in cucumber (*Cucumis sativus* L.)

Raghvendra Singh, Anand Kumar Singh, Sanjay Kumar, BK Singh and SP Singh

Received : Dec 2009 / Accepted : Jan 2011

Abstract Combining ability effects were estimated for different characters of cucumber in a line x tester mating design comprising 12 lines and 3 testers and their 36 F_1 hybrids. Parents and F_1 crosses differed significantly for general combining ability and specific combining ability effects for all the characters respectively. The result revealed high and significant differences among the parents and hybrids for most of the characters except number node to male flower and female flower and length of fruit, indicating the importance of both additive and non-additive gene action. Among the parents, CC-5, BSC-1, and CC-7 were found to be good general combiner for number of primary branches per plant, weight per fruit, number of fruit per plant, fruit yield per plant etc. The cross combination VRC-18 x CC-5, BSC-1 x CC-5 and CC-7 x CHC-1 were found to be good specific combiner for fruit yield and its related contributing characters.

Keywords: Combining ability, cucumber, GCA, SCA, Line x tester

Introduction

Cucumber (*Cucumis sativus* L.) is an important vegetable crop for both internal market and export purpose, grown for its tender green fruits during summer and rainy season throughout the country. The genetic improvement of yield and its contributing characters require the selection of appropriate breeding procedures which is largely dependent upon the study of general combining ability (gca) of parents and specific combining ability (sca) of hybrids. The general combining ability in respect of characters is the manifestation of additive gene action for the selection of parents, while, the specific combining ability in respect of a particular character in the hybrid is the capitalization of non-additive gene action. Line x Tester analysis has been proved to be a useful technique for screening a large number of genotypes with reasonable confidence. The present investigation was, thus, conducted in a line x tester mating design to study the combining ability in respect of fruit yield and its component traits in diverse lines of cucumber under sub-tropical conditions of Varanasi.

Material and Methods

Fifteen parental line of cucumber including 12 lines and 3 testers namely CH-20, CC-4, CC-7, VRC-18, VRC-11-2, CH-6, Swarna Ageta, CH-129, BC-2, CV-5, CH-127 and BC-2; and CC-5, BSC-2 and CHC-1 were used to made crosses in line x tester fashion design to produce 36 crosses. Crosses and their parents were grown with spacing of plant 0.6m and row to row 1.5m at the Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in a Randomized Block Design (RBD) with 3 replication during the Kharif season of 2006 and 2007. All the recommended cultural and management practices were followed to raise a healthy crop. Five competitive plants were selected randomly in each replication for recording observations on 12 parameters namely, number of days to 50% germination, number of days to first male flower anthesis, number of days to first female flower anthesis, number of nodes to first male flower, number of nodes to first female flower, vine length (m), number of nodes per vine, number of primary branches per plant, length of fruit (m), weight per fruit (g), number of fruits per plant, fruit yield per plant (kg). Data was statistically analyzed for the study of combining ability as per Kempthorne.,(1957).

Raghvendra Singh, Anand Kumar Singh, Sanjay Kumar,
BK Singh and SP Singh
Department of Horticultural,
Institute of Agricultural Sciences,
Banaras Hindu University,
Varanasi -221005, (U.P.). India.

Table 1: Analysis of variance for the 12 characters of combining ability in cucumber.

Source of variation	*D.F.*	*Characters*											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Replication	*2*	0.40	1.88	7.48	0.03	0.23	0.72	2.62	0.89	6.51	90.5	0.96	0.08
Lines	*11*	3.07**	44.0**	49.6**	3.27**	7.23**	4.14**	38.3**	9.49**	67.1**	6853**	48.3**	2.70**
Tester	*2*	36.4**	21.5**	36.7**	0.58	0.20	2.54**	21.2**	7.49	1.10	4375**	13.1**	2.16**
Line xTester.	*22*	2.83**	25.1**	25.8**	1.72**	2.66**	2.85**	18.7**	3.57**	12.1**	1223**	9.16**	**1.20
Error	*70*	0.93	4.24	5.59	0.69	0.71	0.62	2.06	0.74	2.96	223	2.53	0.09

*, ** Significant at 5 % and 1% level, respectively.

1. *Number of days to 50% germination*
2. *Number of days to first male flower anthesis*
3. *Number of days to first female flower anthesis*
4. *Number of node to first male flower*
5. *Number of node to first female flower*
6. *Vine length (m)*
7. *Number of node per vine*
8. *Number of primary branches per plant*
9. *Length of fruit (m)*
10. *Weight per fruit (g)*
11. *Number of fruits per plant*
12. *Fruit yield per plant (kg)*

Table 2: Estimation of general combining ability (gca) effect of 15 parents for 12 character in cucumber

Parents	*Symbol*	*Characters*											
Line		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CH-20	*L1*	0.30	-1.31	-0.93**	-0.21	-0.47*	-0.40	-1.94**	-1.55**	-4.51**	-20.9**	-1.76**	-0.55**
CC-4	*L2*	0.04	-0.12	0.74	-0.55**	-0.61*	0.52*	-0.47	0.88**	1.26*	-6.75	2.27**	0.28**
CC-7	*L3*	0.49	3.10	1.83**	0.30	-0.17	0.16	1.99**	0.63**	2.09**	23.5**	1.44**	0.57**
VRC-18	*L4*	-0.15	-2.05	-3.14**	0.05	-0.08	1.10**	1.20**	1.01**	1.55**	4.61	0.95*	0.26**
VRC11-2	*L5*	-0.46	1.73	1.32*	-0.61**	-0.61*	-0.52*	-1.49**	-1.17**	2.22**	-24.4**	-0.19	-0.36**
CH-6	*L6*	0.61	-0.15	-0.32	-0.19	-0.33	-1.00**	-4.18**	-1.48**	-4.98**	-20.8**	-2.53**	-0.63**
SwarnaAgeta	*L7*	-0.08	-2.00	-0.65	-0.08	-0.20	-0.34	0.44	-0.33	3.04*	42.4**	-3.13**	-0.11
CHC-129	*L8*	0.31	3.10	3.71**	-0.48*	-0.60*	0.32	3.90**	0.09	-2.91**	-17.9**	3.59**	0.33**
BSC-1	*L9*	-1.49	-0.25	0.38	-0.06	1.68**	-0.72**	-0.35	1.75**	-1.18*	50.9**	2.39**	1.21**
CU-5	*L10*	0.65	-2.98	-3.96**	0.44*	0.33	-0.50*	0.22	-0.05**	1.68**	18.58**	-3.02**	-0.33**
CHC-127	*L11*	-0.25	2.95	3.12**	-0.24	-0.85**	0.35	1.34**	-0.25**	1.10*	-26.6**	-1.41**	-0.54**
BC-2	*L12*	0.03	-2.02	-2.11**	1.63	1.92**	1.01**	-0.66	0.45*	0.64	-22.5**	1.40**	-0.15
S.E.±F		0.26	0.55	0.63	0.22	0.23	0.21	0.39	0.23	0.46	4.01	0.43	0.08
CD (5%) F		.51	1.09	1.25	.43	.45	.41	.77	.45	.91	7.99	.85	.15
CD (1%) F		0.68	1.45	1.66	0.58	0.60	0.55	1.02	0.60	1.21	10.58	1.13	0.21
Tester													
CHC-1	*T1*	1.00	-0.17	-0.36	-0.11	-0.09	-0.19	-0.89**	-0.46**	-0.20	-7.53**	-0.36*	-0.15**
CC-5	*T2*	0.01	-0.67	-0.78**	-0.04	0.06	0.30	0.49**	0.46	0.63**	12.6**	0.70**	0.28**
BSC-2	*T3*	-1.0	0.84	1.14**	0.14	0.03	-0.11	0.40*	0.01	-0.43*	-5.13**	-0.34	-0.13**
S.E.(gi)±M		0.11	0.24	0.27	0.10	0.10	0.09	0.16	0.10	0.20	1.71	0.18	0.04
CD (5%) M		.21	.47	.53	.19	.19	.17	.31	.19	.39	3.4	.35	.07
CD (1%) M		0.29	0.63	0.71	0.26	0.26	0.23	0.42	0.26	0.52	4.51	0.47	0.10

*, ** Significant at 5% and 1% level, respectively.

Results and Discussion

Analysis of variance for combining ability indicated that mean square due to line were significant for all the characters indicating normal genetic diversity among the lines reflecting greater contribution by these characters toward the combining ability. Variation of tester was also significant for all the characters except node number to male and female flowers; and length of fruit, thus, the variation within the testers was noteworthy and so was their contribution towards the combining ability. The female x male interaction component also emerged significant for all the characters which precede the combining ability contribution heavily in the expression of these traits.

The information regarding general combining ability effects of the parent is of prime importance as it helps in successful prediction of genetric potentiality of crosses, which yield desirable individuals in segregating population of cross pollinated crops. Estimation of gca effect reflected that it was difficult to choose a good combination for all the traits as the combining ability effcts were not consistent for all the yield components. The gca effect of parents have been presented in table - 2. The data clearly reveals that none of the parent were good general combiner for all the characters.

Table 3: Estimation of Specific combining ability (sca) effect of 36 F_1 cross for the 12 characters in cucumber

S.No.	Cross	Characters											
		1	2	3	4	5	6	7	8	9	10	11	12
1	L1xT1	0.59	2.62**	3.17**	-0.25	0.48	-1.27**	-4.25**	-0.49	-1.96**	0.88**	-1.69**	-0.20
2	L1xT2	0.55	-0.77	-1.92*	-0.84*	-0.73*	1.24**	1.34*	-0.77*	3.90**	22.2**	-1.19*	0.05
3	L1xT3	-1.14**	-1.85*	-1.24	0.60	0.25	0.03	2.91**	1.25**	-1.94**	-23.1	2.88**	0.15
4	L2xT1	0.31	0.75	0.37	-0.40	-0.15	-1.54**	-4.32**	2.22**	0.61**	7.64**	0.29	0.16
5	L2xT2	-0.02	-1.34	-2.11*	1.01**	-0.07	0.53	0.89	-2.22**	-1.41*	-24.2**	2.44**	0.05
6	L2xT3	-0.28	0.56	1.74	-0.6	0.20	1.01**	3.42**	0.01	0.81	16.5**	-2.76**	-0.21
7	L3xT1	0.10	-4.94	-4.92**	-0.64**	-1.03**	0.05	0.47	-0.54	1.42*	-9.03	2.03**	0.25*
8	L3xT2	0.44	-1.62*	-0.92	-0.38*	-0.06	-0.19	-1.78**	0.51	-1.90**	18.1**	-1.79**	0.07
9	L3xT3	-0.55	0.59	5.83**	1.02	1.09**	0.14	1.31	0.03	0.49	-9.10	-0.23	-0.18
10	L4xT1	0.13	2.76**	2.64**	-0.33	-0.66*	0.32	0.70	-0.74*	-0.25	-6.72	-1.59**	-0.37**
11	L4xT2	0.46	-2.10**	-2.28*	0.33	0.68	-0.54	-1.65**	0.96**	0.56	-11.2*	1.25*	0.06
12	L4xT3	-0.60	-0.66	-0.36	0.01	-0.02	0.86*	0.95	-0.25	-0.31	17.9**	0.34	0.31**
13	L5xT1	0.86*	-1.42	-1.49	0.19	0.18	0.87*	2.75**	1.15**	1.01	2.97	-0.33	0.01
14	L5xT2	-0.26	3.53**	3.82**	0.60	1.09**	-0.38	-1.55**	-0.58	-0.70	-12.8*	0.95	-0.06
15	L5xT3	-0.60	-2.10*	-2.33*	-0.79*	-1.26**	-0.49	-1.20*	-0.57	-0.30	9.90	-0.62	0.05
16	L6xT1	-1.34**	-1.88*	-1.24	0.28	0.15	-0.48	-1.74**	-0.51	-2.03**	7.42	0.28	0.14
17	L6xT2	0.96*	1.12	0.80	0.45	1.01**	1.11**	5.06**	0.95**	4.64**	-8.10	0.15	-0.11
18	L6xT3	0.38	0.77	0.44	-0.73*	-1.15**	-0.62*	-3.33**	-0.43	-2.58**	0.68	-0.43	-0.03
19	L7xT1	-2.04**	0.63	0.48	0.44	0.80*	1.44**	0.34	-0.48	0.86	9.42	-0.82	-0.08
20	L7xT2	1.03**	-1.86*	-0.01	-0.31	-0.53	-1.24**	-0.34	0.76*	-1.48*	-20.4**	0.88	-0.02
21	L7xT3	1.01**	1.24**	-0.47	-0.14	-0.27	-0.20	0.01	-0.28	0.62	11.0*	-0.07	0.10
22	L8xT1	0.41	4.14	3.34	0.38	0.67*	0.71*	2.06**	-0.08	1.77**	11.5*	0.55	0.23
23	L8xT2	-0.30	-0.34	-1.38	-0.64*	-1.47**	-1.01**	-0.50	-0.43	-1.71*	-6.30	0.50	0.01
24	L8xT3	-0.11	-381**	-1.97*	0.26	0.81*	0.30	-1.56**	0.52	-0.06	-5.21	-1.05	-0.23
25	L9xT1	-0.69	2.18**	3.90**	0.62	-0.29	0.08	0.93	-0.35	0.70	5.97	-1.34*	-0.24*
26	L9xT2	-0.27	-0.62	-1.51	-0.12	0.01	0.16	-0.02	0.65*	-1.40*	0.79	0.89	0.28*
27	L9xT3	0.96*	-1.56*	-2.39**	-0.50	0.29	-0.24	-0.91	-0.30	0.70	-6.76	0.44	-0.04
28	L10xT1	0.01	-1.15	-1.17	-0.56	-0.95*	0.23	1.78**	1.14**	-0.61	-6.69	1.38*	0.19
29	L10xT2	-1.04**	0.99	1.88*	0.03	0.76*	-0.78*	-1.67**	-1.56**	-1.13*	8.79	-1.16	-0.16
30	L10xT3	1.04**	0.15	-0.71	0.53	0.19	0.55	-0.11	0.42	1.74**	-2.10	-0.22	-0.03
31	L11xT1	0.76*	-1.56*	-1.78*	0.77*	0.15	0.56	0.04	-0.75*	-0.55	-6.14	0.30	-0.04
32	L11xT2	-0.29	2.52*	2.13*	0.14	0.74*	-0.26	0.55	0.64	-0.70	-16.3**	0.50	-0.16
33	L11xT3	-0.47	-0.96	-0.35	-0.91	-0.89*	-0.29	-0.58	0.10	1.25	22.4**	-0.54	0.20
34	L12xT1	0.90*	-2.13	-3.32**	-1.01**	0.67**	-0.32	1.25*	-0.58	-0.97	-17.2**	1.19*	-0.20
35	L12xT2	-1.25**	0.49	1.51	-0.27	-1.43**	1.37**	-0.34	1.09**	1.37*	49.5**	-3.43**	0.13
36	L12xT3	0.35	1.64*	1.81*	1.27**	0.76	-1.06**	-0.91	-0.49	-0.40	-32.3	2.24**	-0.10
S.E.±.		0.37	0.78	0.90	0.32	0.32	0.30	0.55	0.33	0.65	5.67	0.60	0.12
CD (5%) hybrids		0.73	1.55	1.79	0.63	0.63	0.59	1.09	0.65	1.29	11.3	1.19	0.23
CD (1%) hybrids		0.97	2.05	2.37	0.84	0.48	0.79	1.45	0.87	1.71	14.96	1.58	0.31

*, ** Significant at 5% and 1% level, respectively.

The top three parent proved to be the best general combiner for different characters were BSC-1, BSC-2 and VRC-11-2 for days to fifty percent germination; CU-5, VRC-18, and BC-2 for number of days to first male flower anthesis and days to first female flower anthesis; VRC-11-2, CC-4 and BC-2 for number of nodes to first male flower, CHE-127 VRC-11-2 and CC-4 for number of nodes to first female flower; VRC-18, BC-2, and CC-4 for vine length, CHC-129, CC-7, and CHC-127 for number nodes per vine; BSC-1, VRC-18 and CC-4 for number for primary branches per plant; Swarna Ageta, JRC-11-2 and CC-7 for length of fruit, BSC-1 Swarna Ageta and CC-7 for weight per fruit, CHC-129, BSC-1, and CC-4 for number of fruits per plant; and BSC-1, CC-7, and CHC-129 for fruit yield per plant. Similar findings were also reported by Choudhary *et al.*,(2006), Bairagi *et al.*, (2001) and Prasad and Singh., (1994).

In the present investigation, the thirty six hybrids manifested consistently high sca effects for most of the characters. Similar finding were also reported by Bhatnagar., (1998). The present findings revealed that

the significant and desirable crosses in order of merit were Swarn Ageta x CHC-1, CH-6 x CHC-1 and BC-2 x CC-5 for days to fifty percent germination, CC-7 x CHC-1, CHC-129 x BSC-2 and BC-2 x CHC-1 for days to first male flower anthesis, CC-7 x CHC-1, BC-2 x CHC-1 and BSC-1 x BSC-2 for days to first female flower anthesis, BC-2 x CHC-1, CH-20 x CC-5, BC-2 x CC-5 and VRC-11-2 x BSC-2 for node number to first female flower; Swarna Ageta x CHC-1, BC-2 x CC-5 and CH-20 x CC-5 for vine length, CH-6 x CC-5, CC-4 x BSC-2 and CH-20 x BSC-2 for number of node per vine, CC-4 x CHC-1, CH-20 x BSC-2 and CU-5 x CHC-1 for number of primary branches per plant; CH-6 x CC-5 CH-20 x CC-5 and CHC-120 x CHC-1 for length of fruit, BC-2 x CC-5 CHC-127 x BSC-2 and CH-20 x CC-5 for weight per fruit; CH-20 x BSC-2, CC-4 x CC-5 and BC-2 x CC-5 for number of fruits per plant and VRC-18 x BSC-2, BSC-1 x CC-5 and CC-7 CHC-1 were significant and desirable for fruit yield per plant. Similarly, a critical examination of per se performance of three best crosses for the twelve characters also revealed that there is no direct relationship between the *per se* performance of the crosses and their parents.

सारांश

12 लाईन और 3 परीक्षक और उसके 36 F_1 संकर को लाइन x परीक्षक मैटिग आकार में खीरा के विभिन्न गुणों के लिए संयोजक क्षमता प्रभाव का निरीक्षण किया। प्रजनक और संकर क्रमशः सभी गुणों के लिए सामान्य और विशिष्ट संयोजक क्षमता के लिए सार्थक विभिन्नता थी। परिणाम द्वारा ज्ञात हुआ कि योगज और योगज जीन कार्य के महत्वपूर्ण प्रदर्शन सभी गुणों के लिए केवल गांठ संख्या पितृ फूल और मातृ फूल और लम्बाई को छोड़कर अभिभावक एवं संकरों के लिए सार्थक विभिन्न पाई गयी। अभिभावक के साथ, CS-5, BSC-1 और CC-7 अच्छे सामान्य संयोजक प्रारम्भिक शाखा प्रति पौध, फल भार, फल संख्या प्रति पौध, फल उपज प्रति पौध आदि के लिए पाया गया। संकर संयोजन VRC-18 x CC-7 x CHC-1 फल उपज और उसके सहयोगी गुणों के लिए अच्छा विशिष्ठ संयोजक था।

References

1. Bairagi SK, Singh DK, Hari Har Ram (2002) Studies on heterosis for yield and its attributes in cucumber (*Cucumis sativus* L.). Veg Sci 29: 75-77
2. Bhatnagar M (1998) Heterosis and oombining ability in cucumber (*Cucumis sativus* L.). M Sc (Ag.) Thesis Department of Vegetavle Science, G B Pant University of Agriculture, Technology Pantnagar
3. Choudhary BR, Fagoria MS, Pandey Sudhakar, Rai Mathura (2006) Combining ability Studies for economic attributes in musk melon (*Cucumis melo* L.) Veg Sci 33 (2) 185-187
4. Kempthorne (1957) An introduction to genetic statistics. John Wiley and Sons, Inc Nete Yorl pp 468-471
5. Prasad VSRK, Singh DP (1994) Standardized potency and combining ability in slicing cucumber. Indian J Hort 51: 77-84