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ANALYSIS OF COMBINING ABILITY IN CUCUMBER (*Cucumis sativus* L.)

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ABSTRACT

Ten parents were crossed in half diallel fashion to get 45 F_1 hybrids at Main Vegetable Research Station, AAU, Anand during 2015-2016. Combining ability of parents and crosses were analysed for yield and other seven characters related to earliness and quality viz., days to opening of first male flower, days to opening of first female flower, days to first harvest, days to last harvest, total soluble solids, total sugar content and total chlorophyll content. The magnitude of variance due to specific combining ability was higher in comparison to variance due to general combining ability for all the characters studied indicating larger influence of non additive genetic variance in comparison to additive genetic variance. The predictability ratio was also found less than 0.5 for all the characters studied which further confirmed the preponderance of non-additive gene action. The parent ACUS 13-60 exhibited the highest gca effect and the hybrid ACUS 13-60 x ACUS 9-51 depicted the highest sca effect for fruit yield per plant.

Keywords: Cucumber, General Combing Ability, Specific Combining Ability

1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) is an important cucurbitaceous vegetable grown in tropical and subtropical countries. It is believed to be originated in India and wide range of variability is available for the improvement of different characters in this crop. But little work has been done to exploit it. Heterosis breeding is a useful tool for exploiting the genetic variability in a cross pollinated crop like cucumber. But selection of parents on the basis of their per se performance does not necessarily lead to fruitful results and combining ability analysis for different characters is vital for hybrid breeding. It is also useful in identification and commercial exploitation of superior hybrids. Therefore, the present investigation was undertaken to analyse the general combining ability of parents and specific combining ability of the crosses.

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1.1 Research methods

Ten lines of cucumber (GCU 1, ACUS 9-44, ACUS 9-50, ACUS 13-58, ACUS 14-63, ACUS 13-60, ACUS 9-51, ACUS 14-62, ACUS 14-64 and ACUS 14-65) collected from breeding material maintained at MVRS, AAU, Anand were crossed in half diallel fashion during *Kharif*, 2015 and summer, 2016. The experimental material (10 parents and 45 F_1s) was grown in RCBD with two replications at MVRS farm, Anand during *kharif*, 2016. Observations were taken for fruit yield per plant, different characters related to earliness *viz.*, days to opening of first male flower, days to opening of first female flower, days to first harvest and days to last harvest and quality characters *viz.*, total soluble solids, total sugar content and total chlorophyll content. Combining ability analysis was computed on data obtained for parents and F_1s following Griffing (1956) Model I and Method II. Predictability ratio (Baker, 1978) was also worked out to study the gene action involved in the inheritance of the characters.

1.1.1 Analysis results

Both the variances, due to general combining ability (σ^2_{gca}) and specific combining ability (σ^2_{sca}) were significant (Table 1) for all the characters revealing the importance of both general combining ability and specific combining ability variances for their inheritance. The magnitude of variance due to specific combining ability was higher in comparison to variance due to general combining ability for all the characters indicating larger influence of non additive genetic variance in comparison to additive genetic variance. The lower estimate (below 0.5) of predictability ratio for all the characters also indicated that variance due to specific combining ability was pronounced for inheritance of these traits. The results obtained for fruit yield per plant are in agreement with the findings of Uddin *et al.* (2009), Kushwaha *et al.* (2011), Mule *et al.* (2012), Kumar *et al.* (2013), Reddy *et al.* (2014) and Pati *et al.* (2015).

Table 1: Analysis of variance for combining ability and genetic components

Source of variation	df	FYP	DOM	DOF	DFH	DLH	TSS	TSC	TC
Parents (GCA)	9	4.15**	10.45**	9.83*	13.35*	207.85**	0.46**	0.14**	9.53**
Hybrids (SCA)	45	0.98**	10.23**	7.57*	9.03*	66.03**	0.32**	0.30**	4.75**
Error	54	0.10	3.30	4.17	5.64	28.43	0.02	0.004	0.06
Predictability ratio	-	0.38	0.01	0.10	0.18	0.39	0.07	0.00	0.15
σ^2_{gca}	-	0.26**	0.02**	0.19*	0.36*	11.82**	0.01**	0.00**	0.40**
σ^2_{sca}	-	0.88**	6.93**	3.40*	3.39*	37.59**	0.30**	0.30**	4.69**

* Significant at 5 per cent probability level, ** Significant at 1 per cent probability level

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The parents ACUS 13-60 (1.37), GCU 1 (-1.01), ACUS 9-51 (-1.52), ACUS 9-51 (-2.02), ACUS 13-60 (8.61), ACUS 13-60 (0.25), ACUS 14-62 (0.12) and ACUS 9-44 (1.26) recorded the highest gca effect (Table 2) for the characters, fruit yield per plant, days to opening of first male flower, days to opening of first female flower, days to first harvest, days to last harvest, total soluble solids, total sugar content and total chlorophyll content.

The results revealed that for fruit yield, parents ACUS 13-60 and ACUS 9-44 were good general combiners, of which, parent ACUS 13-60 was also good general combiner for other characters *viz*., days to last harvest, total soluble solids and total sugar content and average general combiner for days to opening of first female flower and days to first harvest. Both the parents may be extensively used in crossing programme to accumulate desirable genes of various characters in limited genotypes leading to gene pyramiding, which may have immense value as pre-breeding material and for heterosis breeding as well.

The sca effect of hybrids for different characters is given in Table 3. For fruit yield per plant and days to last harvest, the cross ACUS 13-60 x ACUS 9-51 registered highest sca effect. For days to opening of first female flower and days to first harvest, ACUS 9-50 x ACUS 13-58 manifested highest sca effect.

Table 2: Estimates of general combining ability (gca) effect of parents for different characters in cucumber

Parents	FYP	DOM	DOF	DFH	DLH	TSS	TSC	TC
GCU 1	-0.03	-1.01*	1.18*	1.24	3.27*	0.21**	-0.06**	0.69**
ACUS 9-44	0.31**	-0.10	0.96	0.24	1.79	0.23**	-0.02	1.26**
ACUS 9-50	-0.56**	-0.25	0.96	1.20	-5.11**	-0.05	0.10**	1.15**
ACUS 13-58	-0.75**	-0.89	-0.67	1.28*	-4.05**	-0.03	-0.15**	-0.09
ACUS 14-63	-0.45**	-0.67	-0.49	-0.53	-3.79*	-0.10**	0.10**	-1.55**
ACUS 13-60	1.37**	1.55**	0.18	-0.90	8.61**	0.25**	0.07**	-0.49**
ACUS 9-51	0.15	-0.84	-1.52**	-2.02**	0.48	-0.39**	-0.19**	0.17**
ACUS 14-62	0.12	0.40	-1.01	-0.42	2.09	0.07*	0.12**	-0.69**
ACUS 14-64	-0.18*	1.45**	0.30	-0.04	-2.38	-0.07*	0.05**	0.27**

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ACUS 14-65		0.04	0.35	0.10	-0.04	-0.9	-0.14**	-0.02	-0.72**
Range of gca effects	Min.	-0.75	-1.01	-1.52	-5.11	-0.39	-0.19	-1.55	-2.02
	Max.	1.37	1.55	1.18	8.61	0.25	0.12	1.26	1.28
Sig. positive		2	2	1	1	2	4	5	5
Sig. negative		4	1	1	1	3	4	3	4
S.E. (g_i)		0.08	0.49	0.55	0.65	1.46	0.04	0.02	0.07
C.D. (g_i) at 5 %		0.17	0.97	1.09	1.27	2.86	0.07	0.03	0.13

* Significant at 5 per cent probability level, ** Significant at 1 per cent probability level

The crosses depicting highest sca effect for the other characters days to opening of first male flower, total soluble solids, total sugar content and total chlorophyll content were GCU 1 x ACUS 14-62 (-5.52), ACUS 14-63 x ACUS 14-65 (1.29), ACUS 13-60 x ACUS 14-64 (1.56) and ACUS 9-51 x ACUS 14-62 (6.12). These cross combinations may be favoured for commercial cultivation as hybrids after critical evaluation in varied environments or over locations. These hybrids may also be advanced for development of superior desirable recombinants as improved varieties.

Table 3: Estimates of specific combining ability (sca) effect of hybrids

Hybrids	FYP	DOM	DOF	DFH	DLH	TSS	TSC	TC
P_1 x P_2	0.05	2.18	-2.28	0.54	10.42**	-0.08	0.81**	-2.87**
P_1 x P_3	1.24**	1.23	-1.28	0.19	6.31**	-0.81**	-0.03	-0.11
P_1 x P_4	1.32**	0.57	-2.55	-3.99	7.95**	0.47**	0.10	1.51**
P_1 x P_5	0.58	3.65*	3.57	3.02	5.30**	0.24	-0.45**	-2.86**
P_1 x P_6	-1.39**	-0.77	-0.40	1.09	-4.00*	0.20	-0.54**	0.61**
P_1 x P_7	0.69*	-3.88*	-0.60	-1.70	2.83	0.13	-0.09	-2.70**
P_1 x P_8	0.70*	-5.52**	-4.21*	-4.19	-1.88	-0.13	0.78**	-2.56**
P_1 x P_9	-0.71*	-1.87	0.88	-1.67	-10.51**	-0.69**	-0.34**	3.98**

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P_1 x P_{10}	-1.17**	1.63	1.88	3.43	-13.30**	0.58**	-0.42**	-0.73**
P_2 x P_3	-0.94**	-0.98	3.54	3.09	-12.70**	-1.12**	0.63**	2.38**
P_2 x P_4	1.25**	1.96	-0.03	-1.79	-1.36	0.26*	-0.29**	-2.63**
P_2 x P_5	0.08	-2.06	-2.12	-2.88	4.68*	-0.07	-1.00**	-0.81**
P_2 x P_6	-0.52	-1.08	-2.58	-1.01	-3.22	-0.32*	-0.68**	-0.45*
P_2 x P_7	0.21	1.31	0.12	0.60	5.61**	0.12	-0.01	3.39**
P_2 x P_8	-0.12	-1.82	-2.09	-2.19	-7.2**	0.16	-0.03	-0.63**
P_2 x P_9	0.24	-1.88	1.80	-0.07	3.77	-0.20	-0.55**	-0.18
P_2 x P_{10}	-0.37	-2.57	-1.20	-1.57	-6.01**	0.27*	0.95**	-0.19
P_3 x P_4	0.19	-3.6*	-5.73**	-4.65*	-0.37	-0.47**	-0.46**	-1.65**
P_3 x P_5	1.34**	1.68	-0.81	-1.34	0.87	1.10**	-0.39**	2.86**
P_3 x P_6	-1.44**	-3.84*	0.02	-1.07	-5.63**	-0.49**	-0.4**	0.34
P_3 x P_7	-0.61*	-1.35	-5.08**	-3.56	2.10	0.14	0.07	-3.47**
P_3 x P_8	0.53	1.62	4.22*	2.65	-4.90*	0.38**	-0.01	-1.29**
P_3 x P_9	0.14	-2.34	0.11	-2.33	-0.44	0.52**	0.78**	-2.14**
P_3 x P_{10}	0.64*	0.67	3.51	2.97	4.98*	0.64**	-0.46**	-0.94**
P_4 x P_5	0.92**	-2.77	-0.48	-1.51	2.91	-0.72**	0.29**	-0.64**
P_4 x P_6	-0.53	-2.8	0.25	-1.25	-11.19**	0.23	0.04	-0.33
P_4 x P_7	-0.20	3.89*	-0.85	-1.63	-7.55**	-0.63**	0.91**	0.02
P_4 x P_8	-0.56	-0.24	-0.56	-1.42	-2.76	0.86**	-0.28**	1.82**
P_4 x P_9	-1.07**	-3.10	-1.27	-1.71	-9.60**	0.05	-0.51**	2.99**
P_4 x P_{10}	-0.94**	-4.19*	-1.97	-3.81	-1.18	-0.08	-0.38**	-1.14**
P_5 x P_6	-0.78**	-3.32*	-3.13	-3.44	-11.45**	-0.94**	0.93**	-0.78**
P_5 x P_7	0.26	-1.52	0.17	-0.82	-4.41*	0.24	-0.39**	-1.20**

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P_5 x P_8		0.02	-0.86	2.56	-0.21	3.78	-1.12**	0.15*	2.19**
P_5 x P_9		-0.82**	-4.32**	-2.75	-0.90	-1.45	-0.33*	0.59**	-1.43**
P_5 x P_{10}		-0.69*	-2.11	-1.45	-0.50	-2.74	1.29**	0.67**	-0.78**
P_6 x P_7		2.87**	4.85**	4.50*	4.44*	17.89**	0.10	-0.39**	-2.02**
P_6 x P_8		1.59**	4.02*	-0.31	0.55	12.38**	0.03	-0.11	-0.09
P_6 x P_9		1.17**	1.96	3.28	2.87	14.95**	0.43**	1.56**	-0.86**
P_6 x P_{10}		0.96**	-0.33	-3.02	-2.43	8.36**	-0.15	0.07	2.22**
P_7 x P_8		-0.58	-3.89*	-2.21	-1.73	-6.69**	0.27*	-0.28**	6.12**
P_7 x P_9		1.02**	-0.05	1.08	2.19	1.28	-0.59**	0.14*	0.13
P_7 x P_{10}		-0.75*	0.76	-1.72	-0.91	-13.50**	-0.27*	-0.32**	-1.68**
P_8 x P_9		-0.63*	-3.18	-3.33	-0.61	11.67**	0.25	-0.20**	-0.99**
P_8 x P_{10}		0.00	-0.67	2.57	3.99	1.59	-0.33*	0.32**	-1.51**
P_9 x P_{10}		-0.59*	4.67**	0.07	1.01	0.85	-0.84**	-0.59**	-1.63**
Range		-1.44 to 2.87	-5.52 to 4.85	-5.73 to 4.50	-13.50 to 17.89	-1.12 to 1.29	-3.47 to 6.12	-1.00 to 1.56	-4.65 to 4.44
Sig. Cross	+ve	13	5	2	12	12	11	14	1
	-ve	14	8	3	15	15	26	21	1
SE (S_{ij})		0.29	1.67	1.88	2.18	1.97	0.13	0.06	0.24
CD (S_{ij}) 5%		0.58	3.27	3.68	4.28	3.86	0.25	0.12	0.47

* Significant at 5 per cent probability level, ** Significant at 1 per cent probability level

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REFERENCES

1. Baker, R. J. (1978). Issues in diallel analysis. Crop Science, 18, 533-536.
2. Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. Australian Journal of Biological Sciences, 9, 463-493.
3. Kumar, J., Munshi, A. D., Kumar, R., Sureja, A. K., & Sharma, R. K. (2013). Combining ability and its relationship with gene action in slicing cucumber. Indian Journal of Horticulture, 70, 135-138.
4. Kushwaha, M. L., Yadav, L. B., & Maurya, R. P. (2011). Heterosis and combining ability in cucumber (*Cucumis sativus* L.). Progressive Agriculture, 11, 103-107.
5. Mule, P. N., Khandelwal, V., Lodam, V. A., Shinde, D. A., Patil, P. P., & Patil, A. B. (2012). Heterosis and combining ability in Cucumber (*Cucumis Sativus* L.). The Madras Agricultural Journal, 99, 420-423.
6. Pati, K., Munshi, A. D., Behera, T. K., Kumar, R., & Karmakar, P. (2015). Estimating combining ability for yield and yield contributing traits in cucumber. Indian Journal Horticulture, 72, 49-53.
7. Reddy, A. N. K., Munshi, A. D., Behera, T. K., Sureja, A. K., & Sharma R. K. (2014). Studies on combining ability in cucumber. Indian Journal Horticulture, 71, 349-353.
8. Uddin, M. N., Hossain, M. M., Rahman, M. M., Ahmad, S., & Quamruzzaman, A. K. M. (2009). Combining ability and gene action in cucumber (*Cucumis sativus* L.). SAARC Journal of Agriculture, 7, 63-71.

