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Combining Ability Studies in Cucumber (*Cucumis sativus* L.)

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ABSTRACT

The present study on combining ability for yield and its components was carried out in a set of 27 F_1 hybrids of cucumber obtained from a line × tester method involving 12 diverse parents at Zonal Agriculture and Horticulture Research Station (ZAHRS), Navule, Shivamogga, Karnataka during rabi 2016-17. The ratio of the genetic variance was less than unity, which indicated the predominance of the non-additive gene action. The analysis revealed that none of the parents were found good general combiners for all the traits consistently, however parents US-640, Himangi and Haveri Local were good combiner for fruit yield and its contributing traits. The hybrids DWD × Haveri Local, US-640 × Haveri Local and Sabra × Bagalkot Local exhibited the significant positive specific combining ability (sca) effect for yield attributing traits. These crosses involved poor × average and poor × good combiner parents. Further, improvement in fruit yield could be possible through the hybridization and selection in transgressive segregants.

Key words: *Cucumber, Combining ability, Hybrids, Non-additive gene action*

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most popular vegetables of the family cucurbitaceae, with chromosome number 2n=14. Cucumber is a widely cultivated crop and second most important cucurbitaceous vegetable grown worldwide after water melon. As India is the origin of cucumber a wide range of variability available in this crop. Selection of parents for breeding program is one of the important prerequisite, as general combining ability (*gca*) analysis is one of the strategy to selecting desirable parents and cross combinations were selected based on the *sca* for further exploitation. In this context this experiment was carried out to identify the good general and specific combiner for yield attributing traits.

MATERIAL AND METHODS

Nine genetically diverse genotypes *viz*., Himangi, Sabra, US-640, Phule Shubhangi, NCU-1287, Pebkamal, Dharwad Collection (DWD), US646, Honnavara Collection (Hnr) and three tester *viz*., Haveri Local, Belgum Local and Bagalkot Local were used to produce 27 hybrids.

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All the crosses and their parents were sown in a randomized block design with two replications during 2016-17 at ZAHRS, Navule, Shivamogga, Karnataka. The crop was raised as per the package of practices[1]. The observations were recorded on five randomly selected plants for five economically important characters for earliness and yield attributing traits.

Table 1: Analysis of variance for combining ability for different characters in cucumber

Sources of variations	Days to first female flower appear	Node at first female flower appear	Fruit length (cm)	Fruit diameter (cm)	Fruit rind thickness (mm)	Total Soluble Solids (^{0}Brix)	Number of fruits per vine	Average fruit weight (g)	Yield per vine (kg)	Yield per hectare (t/ha)
GCA	0.88**	0.14**	0.03**	0.10**	0.00**	0.03**	1.78**	140.86**	0.04**	4.57**
SCA	0.49	0.08	0.64	0.06	0.00**	0.06**	1.67**	251.52**	0.06**	7.21**
GCA : SCA	1.81	1.75	0.05	1.65	1.3	0.61	1.07	0.56	0.63	0.63

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

RESULTS AND DISCUSSION

The mean sum of square due to *gca* highly significant for all characters and *sca* highly significant for all traits except days to first female flower, node at first female flower appear, fruit length and fruit diameter (Table 1). It indicated that both additive and non-additive gene action were involved in the expression of these traits. Similar results have been reported by Prajapati[9] in cucumber. The estimates of *sca* variance (σ^2 *sca*) was higher than *gca* variance (σ^2 *gca*). The ratio of *gca*/*sca* variance (σ^2 *gca*/σ^2 *sca*) being lesser than unity revealed preponderance of non-additive gene effects in the inheritance of fruit yield and its components traits. The present findings are in accordance with the reports of Kumar *et al.*[6] and Bairagi *et al.*[2] in cucumber.

The parents and hybrids with negative *gca* and *sca* effects are desirable for days to first female flower appear. US-640 (-0.583) recorded maximum significant negative *gca* effect among the line and Haveri local (-1.056) among the tester exhibited the significant negative *gca* effect for this trait (Table 2). Among 27 cross combinations, 13 crosses exhibited negative *sca* effect DWD × Belgum Local (-1.944) exhibited the maximum negative *sca* effect and lowest in Phule Shubhangi × Bagalkot Local (-0.278). None of the crosses showed the significant *sca* effect for days to first male flower appear (Table 3). Line US-640 (-0.952) exhibited the significant negative *gca* effect for days to first flower appear (Table 2) with respect to tester Haveri Local (-0.402) exhibited the significant negative *gca* effect. The maximum negative *sca* effect of -0.765 was observed in the crosses US-640 × Haveri Local and Pebkamal × Haveri Local. Sabra × Bagalkot Local (-0.043) exhibited the lowest negative *sca* effect. Similar negative gca effect was reported by Mule *et al.*[7], Bairagi *et al.*[2] and Pati *et al.*[8]. Among parents, the line Hnr exhibited the highly significant positive *gca* effect for fruit length and similar result was found by Mule *et al.*[7], Bairagi *et al.*[2], Kumara *et al*.[5] and Pati *et al.*[8] in cucumber. NCU-1287 and Hnr exhibited the highly significant positive *gca* effect for fruit diameter. Out of 27 crosses, 12 exhibited the positive *sca* effect and none of the cross exhibited the significant *sca* effect it is in line with the research findings of Bairagi *et al.*[2] in cucumber and Wani *et al.*[13] in bottle gourd. Among 12 parents, eight showed highly significant *gca* effect. The crosses *viz.*, Himangi × Haveri Local, Himangi × Belgum Local and Himangi × Bagalkot Local exhibited highly significant *sca* effect for fruit rind thickness. Similar result was found by Vashisht *et al.*[12] and Bayoumy *et al.*[3] in muskmelon. Among the lines, US-640, Pebkamal and in tester Havri Local exhibited the highly significant positive *gca* effect and Himangi × Haveri Local, NCU-1287 × Bagalkot Local and Hnr × Haveri Local exhibited the significant positive *sca* for TSS it is in line with the research findings of Vashisht

et al.[12], Bayoumy *et al.*[3] and Kaur *et al*. in muskmelon. The lines, US-640, DWD and a tester Havri Local exhibited the significant positive *gca* effect. All tester except Belgum Local exhibited the highly significant *gca* effect for number of fruits. Out of 27 crosses, seven crosses exhibited highly significant positive *sca* effect for number of fruits. This superiority of *sca* effects may be due to complementary type of gene action or involvement of non-allelic interaction of fixable and non-fixable genetic variance. The present findings are in congruence with reports of Mule *et al.*[7], Bairagi *et al.*[2], Kumara *et al*.[5] and Pati *et al.*[8] in cucumber.

The lines NCU-1287 and Hnr exhibited the highly significant positive *gca* effect and our crosses exhibited the highly significant positive *sca* effect for average fruit weight, it is in line with the research findings of Mule *et al.*[7], Kumara *et al*.[6] and Pati *et al*.[8]. US-640 × Haveri Local, Phule Shubhangi × Belgum Local and DWD × Haveri Local exhibited the positive significant *sca* effect, it is in line with the research findings of Sreevani[11] and Wani *et al.*[13] in bottle gourd. Among 12 parents three exhibited the highly significant positive *gca* effect and US-640 × Haveri Local exhibited the highly significant positive *sca* effect and it is in line with the research findings of Mule *et al.*[7], Bairagi *et al.*[2], Kumara *et al*.[5] and Pati *et al.* [8] in cucumber. DWD × Haveri Local and Sabra × Bagalkot Local exhibited the significant positive *sca* effect. Similar significant *sca* effect was observed by Singh *et al*.[10] in cucumber. Among parent's three lines and a tester exhibited the highly significant positive *gca* effect for yield per hectare, Sabra × Bagalkot Local and DWD × Haveri Local exhibited the significant positive *sca* effect. It is in accordance with the research findings of Singh and Singh[10], Danareddy[4] and Kumara *et al*.[5] in bitter gourd. The cross US-640 × Haveri Local exhibited the highly significant positive *sca* effect and it is in line with the research findings Vashisht *et al.*[12] and Bayoumy *et al.*[3] in muskmelon.

Table 2: General combining ability effects for different characters in cucumber

Parents	Days to first female flower appear	Node No. at first female flower appear	Fruit length (cm)	Fruit diameter (cm)	Fruit rind thickness (mm)	TSS (^{0}Brix)	No. of fruits	Average fruit weight(g)	Yield (kg/vine)	Yield (t/ha)
Lines										
Himangi	-0.267*	-0.285	-0.534	-0.774**	-0.003	0.108	0.900**	4.256	0.237**	2.638**
Sabra	0.467**	0.615*	-2.284*	-1.092**	-0.030**	0.139	-1.467**	-6.111*	-0.261**	-2.89**
US-640	-0.583**	-0.952**	1.682	-0.356	-0.075**	0.191*	2.000**	1.22	0.444**	4.934**
P Shubhangi	0.300*	0.331	-1.548	0.033	-0.035**	-0.459**	-1.367**	4.089	-0.246**	-2.732**
NCU-1287	.250*	0.498*	1.582	0.861**	-0.033**	-0.042	-1.267**	31.222**	-0.061	-6.77
Pebkamal	-0.033	-0.252	-1.484	-0.069	-0.008	0.158*	-1.767**	-3.011	-0.353**	-3.918**
DWD	-0.133	-0.352	-0.368	0.249	0.145**	0.074	4.833**	-51.378**	0.366**	4.064**
US-646	-0.217	-0.152	-0.216	0.384	0.002	-0.142*	-1.000**	-5.844*	-0.186**	-2.066**
Hnr	0.217	0.548*	3.109**	0.763**	0.037**	-0.026	-0.867**	25.556**	0.059	6.56
S. Em ±	0.2355	0.7303	1.0179	0.2468	0.0053	0.0693	0.1751	2.4052	0.0644	0.7152
CD @ 5%	0.234	0.484	2.084	0.507	0.011	0.142	0.360	4.944	0.132	1.470
CD @ 1%	0.6544	2.0294	2.8285	0.6858	0.0147	1.1925	0.4865	6.6834	0.1789	1.9874
Tester										
Haveri Local	-0.317**	-0.402**	-0.258	-0.182	-0.020**	0.196**	0.717**	-3.211*	0.122**	1.354**
Belgum Local	0.111	0.093	0.181	0.037	-0.003	-0.176	-0.989**	2.722	-0.173**	-1.924**
Bagalkot Local	0.206**	0.309*	0.077	0.144	0.023**	-0.020	0.272*	0.489	0.051	0.570
S.Em ±	0.1360	0.4217	0.5877	0.1425	0.0031	0.0400	0.1011	1.3886	0.0373	0.4129
CD @ 5%	0.484	0.280	1.203	0.293	0.006	0.082	0.208	2.854	0.076	0.849
CD @ 1%	0.3778	1.1717	1.6330	0.2929	0.0085	0.1111	0.2809	3.8587	0.1033	1.1474

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

Table3. Estimation of specific combining ability for different characters in cucumber

Crosses	Days to first female flower appear	Node no. at first female flower appear	Fruit length (cm)	Fruit diameter (cm)	Rind thickness (mm)	TSS (^{0}Brix)	No. of fruits per vine	Average fruit weight (g)	Yield/vine (kg/vine)	Yield (t/ha)
Himangi × Haveri Local	-0.811	-0.093	0.174	-0.055**	-0.055**	0.387*	1.750**	-8.332	0.223	2.479
Himangi × Belgum Local	1.089	-0.159	0.036	-0.042**	-0.042**	-0.141	-1.144**	1.744	-0.217	-2.409
Himangi × Bagalkot Local	-0.278	0.252	-0.210	0.097**	0.097**	-0.246	-0.606	6.578	-0.006	-0.070
Sabra × Haveri Local	1.289	0.707	-3.076	0.002	0.002	-0.249*	-1.183**	-41.956**	-0.359**	-3.983**
sabra × Belgum Local	-1.411	-0.659	1.536	0.014	0.014	0.427	0.322	29.011**	0.126	1.405
Sabra × Bagalkot Local	0.122	-0.048	1.540	-0.016	-0.016	-0.178	0.861**	12.944**	0.232*	2.578*
US-640 × Haveri Local	-1.644	-0.726	2.058	0.002	0.002	-0.046	0.450**	8.911*	0.541**	6.016**
US640 × Belgum Local	1.356	0.507	-1.181	0.004	0.004	-0.174	-1.144**	-4.622	-0.239*	-2.650*
US640 × Bagalkot Local	0.289	0.219	-0.877	-0.006	-0.006	0.220	-1.306**	-4.289	-0.303*	-3.366*
Phule Shubhangi × Haveri Local	1.489	0.307	-1.352	0.017	0.017	0.054	-1.583**	-0.556	-0.294*	-3.261*
Phule Shubhangi × Belgum Local	-1.211	-0.059	0.099	0.004	0.004	0.026	0.222	9.111*	0.096	1.072
Phule Shubhangi × Bagalkot Local	-0.278	-0.248	1.253	-0.021*	-0.021*	-0.080	1.361**	-8.556	0.197	2.189
NCU-1287 ×Haveri Local	-0.378	-0.059	2.358	0.010	0.010	-0.113	-0.383	13.411**	-0.029	-3.317
NCU-1287 ×Belgum Local	0.822	0.274	-2.331	-0.002	-0.002	-0.141	0.922**	-4.122	0.171	1.905
NCU-1287 ×Bagalkot Local	-0.444	-0.215	-0.027	-0.008	-0.008	0.254*	-0.539	-9.289*	-0.143	-1.588
Pebkamal ×Haveri Local	-1.544	-0.726	-0.956	0.010	0.100	0.187	-0.883**	17.344**	-0.112	-1.243
Pebkamal ×Belgum Local	1.256	0.507	1.026	0.008	0.008	-0.191	0.422	-14.289**	0.023	0.257
Pebkamal × Bagalkot Local	0.289	0.219	-0.070	-0.018	-0.018	0.004	0.461	-3.056	0.089	0.986
DWD × Haveri Local	1.456	0.774	1.308	-0.003	-0.003	0.221	1.067**	9.311*	0.265*	2.942*
DWD × Belgum Local	-1.944	-0.593	-2.381	0.009	0.009	-0.258*	-1.178**	-4.322	-0.185	-2.058
DWD × Bagalkot Local	0.489	-0.181	1.073	-0.006	-0.006	0.037	0.111	-4.989	-0.080	-0.885
US-646 × Haveri Local	-0.711	-0.359	1.106	0.015	0.015	-0.113	-0.250	5.978	-0.044	-0.484
US-646 × Belgum Local	0.589	0.174	0.922	0.003	0.003	0.159	0.856**	-8.556	0.121	1.350
US-646 × Bagalkot Local	0.122	0.185	-2.028	-0.018	-0.018	-0.046	-0.606	2.578	-0.078	-0.866
Hnr × Haveri Local	0.856	0.174	-1.619	0.000	0.000	-0.329*	-0.983**	-4.122	-0.194	-2.150
Hnr × Belgum Local	-0.544	0.007	2.273	0.003	0.003	0.292*	0.722*	-3.956	0.101	1.128
Hnr × Bagalkot Local	-0.311	-0.181	0.654	-0.003	-0.003	0.037	0.261	8.078	0.092	1.023
S.Em ±	0.4079	1.2650	1.7631	0.4275	0.009	0.1200	0.3033	4.1659	0.1115	1.2388
CD @ 5%	2.263	0.995	3.624	0.019	0.019	0.247	0.623	8.562	0.229	2.546
CD @ 1%	1.1335	3.5151	4.8991	1.1879	0.0255	0.3334	0.8427	11.5761	0.3099	3.4422

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

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