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Heterosis and inbreeding depression for fruit characters in cucumber

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ABSTRACT

Fifteen parental lines and their 36 hybrids were evaluated for heterosis and inbreeding depression of fruit characters, *viz.* fruit length, weight per fruit, number of fruits per plant and fruit yield per plant. The positive heterosis desirable for length of fruit, weight per fruit, number of fruits per plant and fruit yield per plant was common in most of the crosses. Most of the crosses showed positive and significant heterosis over standard variety and better parent. The cross combination BSC-1 × BSC-2, BSC-1 × CHC-1, VRC-11-2 × CC-5 and CC-7 × CHC-1 showed highly positive and significant heterosis over standard variety and better parent and can be utilized in heterosis breeding programme for the improvement of yield in cucumber. In general, crosses showed significant heterosis in F_1 and also revealed inbreeding depression in F_2 population.

Key words: Heterosis, inbreeding depression, fruit characters, cucumber.

INTRODUCTION

Among the cultivated cucurbits, cucumber is one of the most important vegetable grown throughout the country for its high nutritive value and medicinal properties. In India, a wide range of variability in vegetative and fruit characters is available on this crop. Unfortunately, very little attention has been paid for its genetic improvement by using wild genotypes. A speedy improvement can be brought about by assessing the genetical variability and exploitation of heterosis. The exploitation of heterosis is much easier in cross pollinated crops and being cucumber monoecious, provides ample scope for the utilization of hybrid vigour on commercial scale. The present investigations were, therefore, undertaken to study the nature and magnitude of heterotic effects among economic characters in cucumber.

MATERIALS AND METHODS

Fifteen parental cucumber lines 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 plant to plant of spacing 0.6 m and row to row 1.5 m at The Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in a Randomized Block Design with three replications during the *kharif* season of 2007 and 2008. 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 node 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). The data was analyzed statistically for all the characters. Magnitude of heterosis was calculated as percentage of F_1 performance in favourable direction over standard and better parent as suggested by Hays *et al.* (8). Whereas, percentage reduction in performance of F_2 over F_1 was recorded as inbreeding depression. The significance was tested by 't' test.

RESULTS AND DISCUSSION

Range and mean of parents F_1 and F_2 are presented in Table 1. The positive and significant heterosis for length of fruit is desirable because it is directly associated with the increasing of fruit yield per plant. The heterosis value (Table 2) ranged from - 44.24 (CH-6 × BSC-2) to 26.60% (Swarna Ageta × CHC-1) over standard variety and 49.25% (CH-6 × BSC-2) to 13.39% (VRC-18 × CHC-1) over better parent for this trait. Crosses combination CC-7 × CHC-1, Swarna Ageta × BSC-2 and CU-5 × BSC-2 over standard variety and CC-7 × CHC-1, CU-5 × BSC-2 and CC-7 × BSC-2 over better parent were responsible for longest length of fruit. Inbreeding depression ranged from 96.69% (CH-6 × CHC-1)

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Table 1. Range and mean performance of parents, F_1s and F_2s for different characters in cucumber.

Character	Parents			F_1 hybrids			F_2 generation		
	Range		Mean	Range		Mean	Range		Mean
	Min.	Max.		Min.	Max.		Min.	Max.	
Fruit length (m)	10.87	20.33	15.53	9.21	20.89	17.1	8.63	20.1	16.1
Fruit weight (g)	122.0	216.3	162.57	112	236	172	109	241	162
No. of fruits per plant	8.59	17.42	12.01	8.58	18.2	12.8	8.33	18.4	12.9
Fruit yield per plant (kg)	1.31	2.96	1.94	1.31	3.98	2.20	1.32	3.30	2.07

Table 2. Estimation of heterosis and inbreeding depression of 36 F_1 hybrids for fruit characters in cucumber.

Cross	Fruit length			Fruit wt. (g)			No. of fruits per plant			Fruit yield per plant (kg)		
	SV%	BP%	ID%	SV%	BP%	ID%	SV%	BP%	ID%	SV%	BP%	ID%
CH-20 × CH-1	-36.242**	-38.766**	10.361**	-22.010**	-22.220**	0.463	-28.016**	-19.947**	-0.662	-43.777**	-37.915**	-0.763
CH-20 × CC-5	4.303*	-13.518**	21.441**	0.383	9.535**	15.327**	-15.635**	-38.978**	-14.017**	-14.592**	-32.770**	4.523*
CH-20 × BSC-2	-37.515**	-43.133**	-44.229*	-33.644**	-41.386**	-27.817**	8.492**	22.932**	24.653**	-28.326**	-28.936**	2.395
CC-4 × CH-1	14.364**	3.511*	7.207**	-10.690**	-10.930**	-3.217*	19.683**	16.089**	16.976**	6.867**	18.009**	14.056**
CC-4 × CC-5	7.091**	-11.340**	8.998**	-16.981**	-9.412**	5.338**	45.079**	4.937*	26.641**	21.030**	-4.730*	30.496**
CC-4 × BSC-2	14.121**	3.291*	0.903**	-4.582*	-15.714**	12.994**	-4.127**	-7.005**	-35.099**	-8.155**	-8.936**	-17.290**
CC-7 × CH-1	24.242**	12.885**	25.220**	-3.326*	-3.586*	-0.931	26.905**	12.685**	4.128**	23.176**	24.783**	2.787
CC-7 × CC-5	9.091**	-9.684**	7.389**	22.194**	33.335**	17.647**	4.921*	-24.110**	-6.732**	28.326**	1.014	11.706**
CC-7 × BSC-2	17.152**	6.443**	-1.190	-2.065**	-13.491**	10.095**	9.127**	-3.101*	-11.491**	6.009**	5.106**	-0.405
VRC-18-4 × CH-1	10.848**	13.391**	15.145**	-12.307**	-12.543**	-39.134**	-5.714**	-6.235**	26.094**	-16.738**	-8.056**	-2.062
VRC-18-4 × CC-5	20.788**	0.151	18.063**	-3.865*	4.900*	-34.958**	25.159**	-9.472**	33.608**	20.172**	-5.405**	10.000**
VRC-18-4 × BSC-2	9.091**	-0.717	4.278**	2.291	-9.643**	-11.025**	9.841**	9.234**	7.876**	13.305**	12.340**	-2.273
VRC-11-2 × CH-1	22.545**	5.258**	10.633**	-22.733**	-22.941**	2.791	-4.762*	2.564	-17.500**	-26.180**	-18.483**	-13.954**
VRC-11-2 × CC-5	17.152**	-3.011*	14.382**	-20.394**	-13.135**	2.032	13.730**	-17.738**	-2.303	-10.300**	-29.392**	-0.957
VRC-11-2 × BSC-2	13.212**	-2.759	48.180**	-17.698**	-27.300**	6.334**	-6.905**	0.256	0.512	-23.605**	-24.255**	5.056**
CH-6 × CH-1	-39.515**	-38.128**	-96.693**	-18.421**	-18.640**	11.399**	-18.492**	-9.356**	-16.845**	-33.047**	-26.066**	-1.923
CH-6 × CC-5	5.697**	-12.494**	-2.523	-15.903**	-8.235**	23.506**	-11.191**	-35.764**	-30.027**	-24.893**	-40.878**	1.143
CH-6 × BSC-2	-44.242**	-49.255**	-34.891**	-20.755**	-30.000*	15.190**	-23.968**	-13.849**	-29.436**	-39.914**	-40.426**	-10.000**
Swarna Ageta × CH-1	26.606**	2.755	29.775**	16.803**	11.686**	23.847**	-31.905**	-24.272**	-26.807**	-20.172**	-11.848**	3.763**

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Table contd...

Cross	Fruit length			Fruit wt. (g)			No. of fruits per plant			Fruit yield per plant (kg)		
	SV%	BP%	ID%	SV%	BP%	ID%	SV%	BP%	ID%	SV%	BP%	ID%
Swarna Ageta × CC-5	17.394**	-4.722*	19.102**	11.590**	6.701**	6.923**	-10.079**	-34.960**	-5.649**	1.288	-20.270**	1.695
Swarna Ageta × BSC-2	23.697**	0.394	5.683**	18.960**	5.081**	13.749**	-25.794**	-15.917**	-6.952**	-11.588**	-12.340**	7.282**
CHC-129 × CH-1	-3.939*	-6.765**	-12.681**	-14.647**	-14.876**	-7.579**	32.302**	33.360**	-2.939	12.446**	24.171**	-11.832**
CHC-129 × CC-5	-20.061**	-33.818**	-23.806**	-13.385**	-5.488**	-4.189*	40.238**	1.435	28.297**	20.601**	-5.068**	25.267**
CHC-129 × BSC-2	-16.424**	-23.938**	-38.651**	-22.372**	-31.429**	5.972**	19.762**	20.720**	-1.590	-6.867**	-7.660**	4.608*
BSC-1 × CH-1	0.121	1.350	8.051**	19.499**	2.625	21.654**	7.857**	6.172**	38.043**	30.043**	9.783**	-5.611**
BSC-1 × CC-5	-7.636**	-23.532**	-4.987*	27.585**	9.569**	20.704**	33.810**	-3.215*	-3.974	70.815**	34.459**	17.085**
BSC-1 × BSC-2	-1.273	-10.149**	3.376*	13.925**	-2.162	16.718**	21.984**	20.078**	0.716	39.485**	17.754**	17.231**
CU-5 × CH-1	9.455***	-0.824	3.654*	-4.760*	-5.016**	9.056**	-13.651**	-3.972*	13.235**	-18.026**	-9.479**	20.942**
CU-5 × CC-5	11.273**	-7.878**	-2.233	14.464**	24.900**	23.388**	-25.397**	-46.039**	-8.723**	-14.163**	-32.432**	17.500**
CU-5 × BSC-2	22.303**	10.818**	0.892	-0.987	-12.538**	2.363	-26.191**	-16.367**	-1.613	-25.751**	-26.383**	1.156
CHC-127 × CH-1	6.364**	0.400	-8.262**	-28.841**	-29.032**	0.758	-11.587**	-18.269**	0.808	-36.910**	-30.332**	2.041
CHC-127 × CC-5	10.424**	-8.580**	0.165	-23.450**	-16.471**	-14.085**	0.556	-27.268**	21.310**	-23.176**	-39.527**	10.056**
CHC-127 × BSC-2	15.818**	5.405**	25.013**	-12.129**	-22.381**	-0.202	-15.952**	-22.304**	21.341**	-25.322**	-25.957**	21.839**
BC-2 × CH-1	1.030	-1.186	48.230**	-32.615**	-32.796**	3.736*	19.921**	33.363**	4.169**	-18.884**	-10.426**	7.937**
BC-2 × CC-5	20.182**	-0.502	18.759**	14.286**	24.706**	36.476*	-8.333**	-33.697**	-56.883**	6.009**	-16.554**	1.215
BC-2 × BSC-2	3.030*	-6.233**	17.023**	-39.445**	-46.510**	2.964	28.413**	45.504**	-5.810**	-21.888**	-22.553**	-2.747

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

to 48.23% (BC-2 × CHC-1). Cross combination VRC-11-2 × BSC-2, Swarna Ageta × CHC-1 and CC-7 × CHC-1 showed positive and significant inbreeding depression, whereas, eleven cross combination exhibited negative and significant inbreeding depression. Similar findings were also reported by Srivastava *et al*. (7) in cucumber, and Verma *et al*. (10) in ash gourd.

Weight per fruit is one of the important yield related traits, which influences the yield decisively. The hybrids with positive and significant heterosis are desirable for this vital taints. The heterosis value ranged from -39.44% (BC-2 × BSC-2) to 27.58% BSC-1 × CC-5 over standard variety and - 46.50% (BC-2 × BSC-2) to 33.33% (CC-7 × CC-5) over better parent. Crosses combination CC-7 × SC-2, BSC-1 × CHC-1, and CH-5 × CC-5 over standard variety and BC-2 × CC-5, CH-5 × CC-5, and Swarna Ageta × CHC-1 over better parent showed highest weight of fruits per plant. Inbreeding depression ranged from -39.13% (VRC-18 × CHC-1) to 36.47% (BC-2 × CC-5). The crosses combination CU-5 × CC-5, CH-6 × CC-5, and Swarna Ageta × CHC-1 had highly positive and significant inbreeding depression, but, ten crosses combination showed negative and significant in breeding depression. These results are in agreement with Solanki *et al*. (6).

Enhancing the number of fruits per plant is an important trait which contributes to the yield, hence, positive and significant heterosis effect would be highly desirable. The heterosis value ranged from -31.90% (Swarna Ageta × CHC-1) to 45.07% (CC-4 × CC-5) over standard variety and -46.03% (CU-5 × CC-5) to 45.50 (BC-2 × BSC-2) over better parent. The crosses combination CHC-129 × CC-5, BSC-1 × CC-5 and CHC-129 × CHC-1 over standard variety and BC-2 × CHC-1, BSC-1 × BSC-2 and CH-20 × BSC-2 over better parent showed maximum number of fruits per plant. Inbreeding depression ranged from -56.8% (BC-2 × CC-5) to 38.04% (BSC-1 × CHC-1). The crosses combination VRC-18 × CC-5, CHC-129 × CC-5 and CC-4 × CC-5 showed highly positive and significant inbreeding depression, while, twenty crosses combination showed negative and significant inbreeding depression. Similar trend was reported by Kumbhar *et al*. (2), Bairagi *et al*. (1), and Pandey *et al*. (5).

The positive and significant heterosis value for fruit yield per plant is desirable for exploitation of hybrid vigour. Such high heterosis for fruit yield per plant was due to additive heterotric effect of one or more of the component traits. The heterosic value ranged from -43.77 (CH-20 × CHC-1) to 70.81% (BSC-1 × CC-5) over standard variety and 0.87% (CH-6 × CC-5) to 34.45% (BSC-1 × CC-5) over better parent. The crosses combination BSC-1 × BSC-2, BSC-1 × CHC-1, and CC-7 × CC-5 over standard variety and VRC-11-2 × CC-5,CC-7 × CHC-1 and CHC-127 × CHC-1 over better parent showed highest positive and significant heterosis for fruit yield per plant. Inbreeding depression for these traits ranged form -13.95% (VRC-11-2 × CHC-1) to 30.49% (CC-4 × CC-5). Crosses CHC-129 × CC-5, CU-5 × CHC-1 and BSC-1 × CC-5 showed highly positive and significant inbreeding depression, which is in agreement with the findings of Pal *et al.* (3), and Pandey *et al.* (4).

In the present investigation, considerable amount of heterosis was observed in desired direction of fruit yield and yield related characters. About 36% crosses showed above 22% with significant desired heterosis over standard and better parents for fruit yield. The amount of heterobeltiosis is high (18.22%) with the majority of crosses, hence, heterosis breeding is favoured for commercial purpose as suggested by Swaminathan *et al*. (9). The shortlisted hybrids may be tested for yield and other traits under different agro-climatic conditions for commercial exploitation of hybrid vigour.

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