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RESEARCH ARTICLE

STUDIES ON HETEROSIS AND INBREEDING DEPRESSION IN CUCUMBER (*CUCUMIS SATIVUS* L.)

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ABSTRACT

Heterosis and inbreeding depression were studied for yield and its component traits in a 8X8 parent diallel cross excluding reciprocals. The range of heterosis over better parent was observed -66.16 to 162.43 per cent for yield/vine. The cross combinations, viz., PCUC-15 X PCUC 15-1, PCUC 15-1 x BIHAR 1, EC 43342 x C 98-6, EC 43342 x C 99-10 and PCUC 15-1 X C 98-6 were top hybrids exhibited high heteriosis for yield/vine. Crosse PCUC 15 X PCUC 15-1 was not only exhibited high heterosis for yield/vine but also showed desirable heterosis for five other traits, namely, node number of first male flower, node number of first female flower, fruit length, fruit diameter and fruit weight. These crosses can be advanced for commercial exploitation of hybrid vigour.

Key Words **: Heterosis, Inbreeding depression, Cucumber**

Cucumber (*Cucumis sativus* L.) is one of the most popular vegetable crops of the family Cucurbitaceae grown throughout the tropical and subtropical regions of the world. It has an important place in human diet in the form of green vegetables and salad as well as in the form of medicine. Cucumber has got cooling effect, so in the eastern countries; fruits are often used as cooling vegetable. It is ideal for people suffering from jaundice and allied diseases and also very much useful in preventing constipation. Seeds contain oil, which is helpful for brain development and body smoothness. Hence, it is being used in Ayurvedic preparations (Robinson and Decker-Walter, 1999). Besides this, the whole fruit is used in cosmetic and soap industries.

Cucumber is a highly cross pollinated crop and usually monoecious in nature preferring warm weather and bright light for its better growth and development. However it can be grown in both summer and rainy season, but it can't tolerate cold injury (Rastogi, 1998). It has great scope to utilize hybrid vigour commercially because of its monoecious nature of flowering, more number of seeds per fruit and cultivation around the year throughout the country. Heterosis breeding has come to play a pivot role in crop improvement for high production and productivity. The extent of heterosis over superior/economic parent is a prerequisite for commercial exploitation of hybrid vigour in cucumber. The aim of heterosis study was to identifying the best heterotic combinations and its exploitation for commercial purpose.

MATERIALS AND METHODS

Eight genotypes of cucumber; namely, PCUC 15, EC 43342, PCUC 15-1, CHC 2, BIHAR 1, C 99-12, C 98-6 and C 99-10 were used to make all possible crosses excluding reciprocals. The experiment material consisting 8 parents, 28 F_1s and 28 F_2s was sown in randomized block design with three replications at Department of Vegetable Science, C. S. Azad University of Agriculture and Technology, Kanpur. All the parents and F_1s were sown in a single row while F_2s were sown in two rows in each replication. The length of row was kept 6.0 m while row to row and plant to plant distance was maintained at 3.0 m and 5.0 m, respectively. All the recommended agronomic practices were adopted to ensure a good crop. The data were recorded on five selected plants in each parents and F_1s as well as ten plants in F_2s for 10 characters; viz., days to first male flower, days to first female flower, node number of first male flower, node number of first female flower, fruit length (cm), fruit diameter (cm), fruit weight (g), number of fruit/vine, vine length (cm) and yield/vine (g). The mean data of each treatment were used for estimation of heterosis values following the method suggested by Allard (1966). Inbreeding depression was worked out as percentage loss of vigour and size in F_2 generation over the F_1s.

RESULTS AND DISCUSSION

The computed value of heterosis over better parent (Table 1) revealed that none of the crosses exhibited useful significant heterosis for all the traits. Significant and desirable heterosis was observed in 11 crosses for yield/vine, 13 for days to first male flower, 12 for days to first female flower, 8 for node number of first male flower, 4 for node number of first female flower, 2 for fruit length, 3 for fruit diameter, 5 for fruit weight, 9 for number of fruits/vine and 8 for vine length, respectively. The wide range of economic heterosis was observed for yield/vine (-66.16 to 162.43), days to first male flower (-32.34 to 19.78), days to first female flower (-17.65 to 21.65), node number of first male flower (-38.61 to 25.87), node number of first female flower (-37.76 to 31.19), fruit length (-41.71 to 30.13), fruit diameter (-37.92 to 27.19), fruit weight (-60.08 to 135.90), number of fruits/vine (-63.08 to 63.35) and vine length (-37.24 to 24.66). In present study five superior crosses were selected for different attributes (Table 2). These were, C 98-6 x C 99-10, BIHAR 1C 98-6, PCUC 15-1 x C 99-12, EC 43342 x C 99-10 and PCUC 15-1 x BIHAR 1 for days to first male flower, EC 43342 X C 99-10, CHC 2 X C 99-10, C98-6 X C 99-10, BIHAR 1 X C 99-12 and BIHAR 1 X C99-10 for days to first female flower, EC 43342 X CHC 2, CHC 2 X BIHAR 1, PCUC 15 X EC 43342, CHC 2 X C 99-12 and PCUC 15-1 X C 98-

Table 1 : Range of heterosis over better parent for 10 characters in cucumber

Character	Number of significantly superior cross over B.P.	Range of heterosis	Best cross
Days to first male flower	13	-32.34 to 19.78	C 98-6 x C 99-10
Days to first female flower	12	-17.65 to 21.65	EC 43342 x C 99-10
Node no. of first male flower	8	-38.61 to 25.87	EC 43342 x CHC 2
Node no. of first female flower	4	-37.76 to 31.19	CHC 2 x C 98-6
Fruit length (cm)	2	-41.71 to 30.13	CHC 2 x C 99-12
Fruit diameter (cm)	3	-37.92 to 27.19	PCUC 15 x CHC 2
Fruit weight (g)	5	-60.08 to 135.90	PCUC 15 x PCUC 15-1
No. of fruits/vine	9	-63.08 to 63.35	PCUC 15-1 x C 98-6
Vine length (cm)	8	-37.24 to 24.66	PCUC 15-1 x CHC 2
Yield/vine (g)	11	-66.16 to 162.43	PCUC 15 x PCUC 15-1

Table 2 : Desirable estimates of heterosis over better parent and inbreeding depression for 10 characters in cucumber

Character	Hybrid combination	E.H.	I.D.	GCA effects	
				P_1	P_2
Days to first male flower	C 98-6 x C 99-10	-32.34**	-29.07**	-1.87**	1.03**
	BIHAR 1C 98-6	-27.05**	-10.76**	-1.60**	-1.87**
	PCUC 15-1 x C 99-12	-24.08**	7.93**	0.09	-0.77**
	EC 43342 x C 99-10	-23.84**	-10.74**	0.61**	1.03**
	PCUC 15-1 x BIHAR 1	-22.37**	-4.52	0.09	-1.60**
	S.E. ±	0.92	1.15		
Days to first female flower	EC 43342 x C 99-10	-17.65**	-22.28**	-0.69**	0.73*
	CHC 2 x C 99-10	-14.41**	7.28*	0.80**	0.73*
	C 98-6 x C 99-10	-14.06**	-35.48**	-2.56**	0.73*
	BIHAR 1 x C 99-12	-13.23**	7.55*	-1.02**	-0.13
	BIHAR 1 x C 99-10	-12.41**	-13.55**	-1.02**	0.73*
	S.E. ±	1.42	1.28		
Node no. of first male flower	EC 43342 x CHC 2	-38.61**	-52.58**	0.20**	-0.45**
	CHC 2 x BIHAR 1	-23.08**	-70.00**	-0.45**	-0.04
	PCUC 15 x EC 43342	-19.11**	-37.80**	0.21**	0.20**
	CHC 2 x C 99-12	-18.99**	-21.87**	-0.45**	-0.16
	PCUC 15-1 x C 98-6	-18.92**	-9.33	0.10	0.30**
	S.E. ±	0.25	0.34		
Node no. of first female flower	CHC 2 x C 98-6	-37.76**	-94.38**	-0.04	0.25
	EC 43342 x C 99-12	-33.78**	-48.47**	0.35*	-0.12
	CHC 2 x C 99-12	-29.73*	-21.15	-0.04	-0.12
	EC 43342 x C 98-6	-27.27*	-27.88	0.35*	0.25
	PCUC 15-1 x C 99-10	-22.24*	-32.99*	-0.04	-0.48**
	S.E. ±	0.65	0.74		
Fruit length (cm)	CHC 2 x C 99-12	30.13**	44.86**	0.91**	1.07**
	PCUC 15 x PCUC 15-1	26.46**	47.77**	0.95**	0.08
	S.E. ±	0.78	0.64		
Fruit diameter (cm)	PCUC 15 x CHC 2	27.19**	-1.66	0.12	0.20**
	CHC 2 x C 99-12	25.49**	45.28**	0.20**	018**
	PCUC 15 x PCUC 15-1	21.80**	54.44**	0.29**	0.12
	S.E. ±	0.35	0.33		
Fruit weight (g)	PCUC 15 x PCUC 15-1	135.90**	86.31**	33.09**	7.55**
	CHC 2 x C 99-12	68.35**	73.95**	29.48**	18.85**
	EC 43342 x C 99-10	42.24**	31.70**	-18.35**	-27.24**
	PCUC 15-1 x BIHAR 1	15.89**	3.98	7.55**	-27.24**
	PCUC 15-1 x C 99-10	13.96**	32.88**	7.55**	-27.24**
	S.E. ±	5.45	4.72		
No. of fruits/vine	PCUC 15-1 x C 98-6	55.10**	18.42**	0.70**	-0.34**
	PCUC 15-1 x C 99-12	68.35**	59.59**	0.70**	-0.32**
	PCUC 15 x C 98-6	42.24**	29.01**	-0.05	-0.34**
	EC 43342 x BIHAR 1	15.89**	2434**	0.22*	-0.02
	PCUC 1 x CHC 2	13.96**	46.31**	-0.05	0.34**
	S.E. ±	0.47	0.45		
Vine length (cm)	PCUC 15-1 x CHC 2	24.46**	-4.52	5.27**	-4.11**
	PCUC 15-1 x BIHAR 1	17.57**	11.71**	5.27**	-2.49**
	EC 43342 x BIHAR 1	17.48**	14.15**	7.70**	-2.49**
	PCUC 15-1 x C 99-10	16.10**	12.07**	5.27**	-6.60**
	EC 43342 x PCUC 15-1	12.94**	36.60**	7.70**	5.27**
	S.E. ±	5.10	5.83		
Yield/vine (g)	PCUC 15 x PCUC 15-1	162.43**	80.20**	208.56**	133.32**
	PCUC 15-1 x BIHAR 1	51.04**	45.03**	133.32**	-130.02**
	EC 433342 x C 98-6	43.38**	20.19**	-92.69**	-42.69**
	EC 43342 x C 99-10	42.62**	31.71**	-92.69**	-273.77**
	PCUC 15-1 x C 98-6	41.86**	26.70**	133.32**	-154.99**
	S.E. ±	61.09	58.89		

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

6 for node number of first male flower, CHC 2 x C 98-6, EC 43342 X C99-12, CHC 2 X C 99-12, EC 43342 X C 98-6 and PCUC 15-1 X C 99-10 for node number of first female flower, CHC 2 X C 99-12 and PCUC 15 X PCUC 15-1 for fruit length, PCUC 15-1 X CHC 2, CHC 2 X C 99-12 and PCUC 15 X PCUC 15-1 for fruit diameter, PCUC 15 X PCUC 15-1, CHC 2 X C 99-12, EC 43342 X C 99-10, PCUC 15-1 X BIHAR 1 and PCUC 15-1 X C 99-10 for fruit weight, PCUC 15-1 X C 98-6, PCUC 15-1 X C 99-12, PCUC 15 X C 99-6, EC 43342 X BIHAR 1 and PCUC 15 X CHC 2 for number of fruits/vine, PCUC 15-1 X CHC 2, PCUC 15-1 X BIHAR 1, EC 43342 X BIHAR 1, PCUC 15-1 X C 99-10 and EC 43342 X PCUC 15-1for vine length and PCUC-15 X PCUC 15-1, PCUC 15-1 X BIHAR 1, EC 43342 X C 98-6, EC 43342 X 99-10 and PCUC 15-1 X C 98-6 for yield/vine. These five combinations which showed significant desirable heterosis for yield/vine also showed significant inbreeding depression in F_2 generation. Qi and Chui (1991), Vijyakumari *et al*. (1993), Li *et al*. (1995), Dogra *et al*. (1979b), Cramer and Wehner (1999), Wang *et al*. (2002) and Bairagi *et al*. (2002) have also reported similar results in cucumber.

Cross combination PCUC 15 X PCUC 15-1 was best heterotic cross which was not only exhibited high heterosis for yield/vine but also showed desirable heterosis for node number of first male flower, node number of first female flower, fruit length, fruit diameter and fruit weight (Table 3). Crosses, namely, PCUC 15-1 x BIHAR 1, EC 43342 x C 98-6 and EC 43342 x C 99-10 were also top crosses for yield/vine, which

Table 3: Top heterotic crosses over better parent for yield/vine and their performance in related parameter in cucumber

Hybrid combination	E.H. (%)	I.D. (%)	GCA effect P_1	GCA effect P_2	SCA effect F_1	SCA effect F_2	Desirable heterosis in other traits
PCUC 15 x PCUC 15-1	162.43**	80.20**	208.56**	133.32**	1261.27**	-484.68**	III**, IV*, V**, VI**, VII**
PCUC 15-1 x BIHAR 1	51.04**	45.03**	133.32**	-130.02**	318.65**	-0.05	I*, VII**, VIII**, IX
EC 433342 x C 98-6	43.38**	20.19**	-92.69**	-42.69**	278.09**	52.21*	I**, III**, IV**, VIII**
EC 43342 x C 99-10	42.62**	31.71**	-92.69**	-273.77**	385.21**	152.22**	I**, II**, VII**, IX**
PCUC 15-1 x C 98-6	41.86**	26.70**	133.32**	-154.99**	198.68**	305.93**	III**, IV**, VII**, VIII**
CHC 2 x C 99-12	37.53**	73.99**	226.50**	43.10**	982.15**	-420.73**	II**, III**, IV*, V**, VI**, VII**
EC 43342 x BIHAR 1	31.86**	36.00**	-92.69**	-130.02**	349.89**	20.16	I**, II**, VI**, VIII**, IX**
PCUC 15 x C 98-6	28.06**	40.22**	208.56**	-154.99**	108.17**	27.88	III**, VI**
PCUC 15 x C 99-10	26.65**	41.49**	208.56**	-273.77**	135.60**	4.41	IX**
PCUC 15-1 x C 99-10	23.29**	36.98**	133.32**	-273.77**	-182.27**	-279.95**	III**, VII**, IX**

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

Note: (I)-Days to first male flower, (II)- Days to first female flower, (III)- Node no. of first male flower, (IV)- Node no. of first female flower, (V)- Fruit length (cm), (VI)- Fruit diameter (cm), (VII)- Fruit weight (g), (VIII)- No. of fruits/vine, (IX)- Vine length (cm) and (X)- Yield/vine (g).

showed significant heterosis for four other component traits while Cross PCUC 15-1 X C 98-6 exhibited three other component characters. Hybrid combination CHC 2 X C 99-12 exhibited desirable significant heterosis for yield/vine and six other yield contributing attributes. Heterosis for yield might be due to heterotic response via other yield attributing traits. Out of 28 crosses, 11 exhibited high heterosis over better parent for yield/vine which involved high x high, high x low and low x low gca effects of parental combinations.

At the same time of presence of predominantly large amount of non-additive gene action for yield and its related traits as observed in the present study, necessitates the maintenance of the heterozygosity in the population. Genetic variance due to non-additive gene action is non fixable in nature and breeding method such as biparental mating followed by recurrent selection are likely to result in faster rate of genetic improvement for characters governed by such type of gene action. The cross combinations, viz., PCUC-15 X PCUC 15-1, PCUC 15-1 x BIHAR 1, EC 43342 x C 98-6, EC 43342 x C 99-10 and PCUC 15-1 X C 98-6 can be advanced for commercial exploitation of hybrid vigour.

REFERENCES

Allard RW (1960). Principles of Plant Breeding. *John Wiley and Sons*, New York

Bairagi SK, Singh DK and Ram HH (2002). Studies of heterosis for yield attributes in cucumber (*Cucumis sativus* L.). *Veg. Sci*., **29**(1) : 75-77.

Cremar CS and Wehner TC (1991). Little heterosis for yield and yield components in hybrid of six cucumber inbrids. *Euphytica*, **110**(02) : 99-108.

Dogra BS, Rastogi KB, Korla BN and Sharma HR (1979b). Heterosis and combining ability studies for yield and quality characters in cucumber (*Cucumis sativus* L.). *J. Hill Res*., **10**(1) : 39-42.

Li Jain Wu, Li, JW and Zhu, De Wei (1995). Genetic analysis of major agronomic characters in cucumber (*Cucumis sativus* L.). *Acta-Horticulturae*, No. **402** : 388-391.

Qi YT and Chui HW (1991). Studies on early maturity heterosis and its formative basis of yield component traits in cucumber (*Cucumis sativus* L.). *Acta-Horticulturae Sinica*, **18**(4) : 330-334.

Rastogi KB (1998). Cucumber hybrid production. *Breeding and Seed Production CAS Horticulture*, (Veg.), pp.76-80.

Robinson RW and Decker-Walter DS (1999). *Cucurbits*. Cab International, University Press, Cambridge

Vijayakumari P, More TA and Seshadri VS (1993). Heterosis in tropical and temperate gynoecious hybrids in cucumber. *Veg. Sci*., **20**(2) : 152-157.

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