Veg. Sci. 37(1) : 64-66 (2010)

HETEROSIS AND COMBINING ABILITY FOR YIELD AND CONTRIBUTING TRAITS IN CUCUMBER (*CUCUMIS SATIVUS* L.)

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Summary

Combining ability and heterosis studies were carried out through half diallel method using ten parents with six characters. The analysis revealed that none of the parents was found good general combiner for all the characters consistently, however parent Peelibheet local, PCUC-28 and Patna-3 were good combiner for yield and its contributing traits. The gca variances were higher than the sca variances for vine length, polar diameter of fruit, equatorial diameter of fruit, average fruit weight and yield per plant. While other character viz., number of branches per plant had gca variances lower than the sca variances indicating the pre dominance of non additive gene effects. The maximum heterosis for yield was exhibited by VRC-18-2 x Patna -3. The selection should be made for improvement of traits like polar and equatorial diameter of fruit, and yield. While, vine length, number of branches and individual fruit weight may be improved through hybridization.

सारांश

खीरे की 10 प्रभेदो का संकर ओज जनित गुणों और संयोजन क्षमता की मात्रा के लिए अर्ध डायलियल रीति से अध्ययन किया गया। सभी गुणों के लिए किसी भी प्रभेद में सामान्य संयोजन क्षमता नहीं पायी गयी। वाइन की लम्बाई, फल की लम्बाई, फल का भार तथा उपज के लिये जीसीए भिन्नता एससीए से अधिक पाई गयी। उपज के लिये वीआरसी 18–2 × पटना 3 में सबसे अधिक संकर ओज पाया गया।

Introduction

The cucumber (*Cucumis sativus* L.) is one of the important cucurbitaceous vegetable crop from nutritional as well as economic point of view. Cucumber is consumed by all sections of people as fresh salad or pickles. Most of the existing open pollinated cultivars or hybrid varieties either have attained a plateau or are restricted to certain regions. Wide range of genetic variability is available for this crop but little work has been done to exploit it. Thus there is a good scope for improvement in yield and there related traits of cucumber through genetic manipulation. Heterosis breeding is one of the most efficient tools to exploit the genetic diversity in cucumber (Hays and Jones, 1916). The study reported here was designed together information on the extent of heterosis for yield and its components through analysis of 10 x 10 diallel mating design.

Materials and Methods

Ten diverse cucumber inbred lines viz., Swarna Ageti, PCUC-28, Cu-5, VRC-11-2, VRC-18-2, Patna-3, Swarna Sheetal, Peelibheet local, Baramasi and BSC-2 were selected and crossed with all possible combinations (45 F_1s) excluding reciprocals. The F_1s and parents were evaluated under complete randomized block design at research farm of IIVR, Varanasi during 2006. In each row seeds were sown keeping row to row and plant to plant spacing 2m and 40 cm, respectively. Observations were recorded on five competitive plants in each parents and F_1s for each treatment in each replication selected at random for vine length (m), number of branches per plant, polar diameter of fruit (cm), equatorial diameter of fruit (cm), average fruit weight (g) and yield per plant (kg). Combining ability variance and effects were worked out according to Griffing (1956 b) and heterosis was worked out over better parent.

Results and Discussion

The analysis of variance for combining ability showed significant difference due to treatments for all the characters (Table-1). Upon partitioning it was further revealed that variance due to parents and hybrids were also significant for all the characters. The variance due to parents Vs crosses significant for all the characters except number of branches per plant. Almost similar results have been reported by Sirohi *et al.,* (1988) in bottle gourd. Highly significant variances were observed for both general and specific combining ability for all the characters. This indicated that parents and crosses differ significantly with regards to their general and specific combining ability, respectively. The *gca* (general combining ability) variances were higher than the *sca* (specific combining ability) variances for vine length, polar and equatorial diameter of fruit, average fruit weight and yield per plant. This indicated the limited scope of heterosis breeding for these characters and population improvement through recurrent selection should be adopted for exploiting the genetic variances (Kushwaha and Ram, 1996), other characters viz., number of branches per plant, where *gca* variances were lower than the *sca* variances may be improved through hybridization (heterosis) indicating the predominance of non-additive gene effects.

The information regarding *gca* effect of the parent is of prime importance as it helps in successful prediction of genetic potentiality of crosses. Estimate of *gca* effect showed that it is difficult to pick up good general combiner for all the characters together as the combining ability effects were not consistent for all the yield components (Table-2). However, overall evaluation indicated that Peelibheet local and PCUC-28 was best general combiner for yield and most of the yield related traits (Table-2) with regard to specific combining ability (*sca*) effects, the cross PCUC-28 x Peelibheet local was superior for yield, vine length, polar and equatorial diameter of fruit and average fruit weight. Nineteen crosses out of 45 crosses exhibited positive significant *sca* effects for yield per plant, indicating the presence of dominance and epistatic (non-additive) type of gene actions. Similar results were reported by Jankiram and Sirohi (1991).

Significant heterosis over better parent was revealed in order of magnitude by yield per plant (80.95%) followed by vine length (33.12%), average fruit weight (30.09%), number of branches per plant (29.00%), polar diameter of fruit (27.81%) and equatorial diameter of fruit (27.30%). The results are also in conformity with those obtained by Maurya (1994) and Pandey *et al.,* (2002 & 2005). The high heterosis response observed in most of the hybrids further supported the predominant role of non-additive component in the inheritance of the character studied. The top three crosses selected separately on the basis

Table 1. Analysis of variance for combining ability

Source of variation	d.f.	Vine length (m)	Number of branches per plant	Polar diameter of fruit (cm)	Equatorial diameter of fruit (cm)	Average fruit weight (g)	Yield per plant (kg)
gca	9	0.0878**	0.0386**	13.009**	3.177**	540.034**	0.1059**
sca	45	0.0821**	0.0459**	10.113**	2.828**	335.762**	0.0975**
Error	108	0.0007	0.0043	0.240	0.0636	27.806	0.0027

**Significant at 1 per cent level

Table 2. Estimates of general combining ability (*gca*) effects of parents in diallel population

Parents	Vine length (m)	Number of branches per plant	Polar diameter of fruit (cm)	Equatorial diameter of fruit (cm)	Average fruit weight (g)	Yield per plant (kg)
Swarna Ageti	0.09**	0.11**	0.67**	0.31**	-4.85*	-0.05*
PCUC-28	0.08**	0.01	-1.52**	-0.60**	3.43	0.05*
CU-5	-0.04**	-0.07**	1.42**	0.57**	-2.66	-0.02
VRC-18-2	0.01	-0.09**	-1.53**	-0.72**	6.52**	0.04
VRC-11-2	-0.11**	-0.01	0.53**	0.35**	-2.39	-0.02
Patna-3	-0.17**	-0.03	0.05	-0.06	1.28	0.05*
Swarna Sheetal	0.07**	-0.01	0.88**	0.61**	-8.78**	-0.15**
Peelibheet local	0.05**	0.02	0.69**	0.39**	14.24**	0.20**
Baramasi	0.02	0.05	-1.05**	-0.63**	-1.16	-0.06**
BSC-2	0.02	0.02	-0.16	-0.21*	-5.62**	-0.03
gca SE (GI-GJ)±	0.011	0.026	0.200	0.102	2.152	0.021

*,** Significant at 5 and 1 per cent level, respectively

Table 3. Top three hybrids selected separately on the basis of heterosis over better parent and *sca* effects

Characters	Crosses	Heterosis (%)	Crosses	*sca* effects
Vine length (m)	Peelibheet local x Baramasi	33.12**	PCUC-28 x Peelibheet local	0.50**
	VRC-11-2 x Patna-3	32.63**	Peelibheet local x Baramasi	0.47**
	Patna-3 x Peelibheet local	29.60**	PCUC-28 x VRC-18-2	0.39**
Number of branches per plant (cm)	Swarna ageti x BSC-2	29.00**	Swarna ageti x BSC-2	0.35**
	Peelibheet local x BSC-2	25.47**	Swarna ageti x Patna-3	0.32**
	Swarna sheetal x BSC-2	24.40**	VRC-18-2 x VRC-11-2	0.32**
Polar diameter of fruit (cm)	PCUC-28 x Peelibheet local	27.81**	Patna-3 x Baramasi	5.30**
	Baramasi x BSC-2	26.71**	PCUC-28 x Peelibheet local	5.27**
	Peelibheet local x Baramasi	26.33**	Peelibheet local x Baramasi	4.28**
Equatorial diameter of fruit (cm)	PCUC-28 x Peelibheet local	27.30**	Patna-3 x Baramasi	2.81**
	Baramasi x BSC-2	25.68**	PCUC-28 x Peelibheet local	2.75**
	PCUC-28 x Swarna sheetal	25.53**	PCUC-28 x Swarna sheetal	2.47**
Average fruit weight (g)	PCUC-28 x Peelibheet local	30.09**	PCUC-28 x VRC-18-2	46.51**
	PCUC-28 x VRC-18-2	26.38**	PCUC-28 x Peelibheet local	42.16**
	VRC-11-2 x BSC-2	22.30**	VRC-18-2 x Patna-3	20.09**
Yield per plant (kg)	VRC-18-2 x Patna-3	80.95**	PCUC-28 x Peelibheet local	0.61**
	Baramasi x BSC-2	76.06**	VRC-18-2 x Patna-3	0.43**
	PCUC-28 x Peelibheet local	74.42**	Baramasi x BSC-2	0.40**

**Significant at 1 per cent level

of high *sca* effects and heterosis over better parent is presented in table -3. Some of the crosses were observed superior for *sca* effects as well as for heterosis (Bairagi *et al.,* 2005). The parent *viz.*, Patna-3, PCUC-28, Peelibheet local and VRC-18-2 may be used for hybridization for exploitation of heterosis based on specific combining ability and heterosis over better parent (Singh *et al.,* 1999). The crosses VRC-18-2 x Patna-3, PCUC-28 x Peelibheet local, Baramasi x BSC-2 may be tested for yield and other economic traits for performance under different agro-climatic conditions for commercial exploitation of hybrid vigour. On the basis of above findings, it can be concluded that improvement in cucumber for yield and its contributing traits may be brought out through recurrent selection and hybridization.

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