Himachal Journal of Agricultural Research 33 (2):166-169, 2007

Exploitation of heterobeltiosis and standard heterosis for fruit yield and its related component traits in cucumber (*Cucumis sativus* L.)

Susheel Sharma, Yudhvir Singh, Akhilesh Sharma, Gurpreet Singh Khalsa and Naresh Kumar*
Department of Vegetable Science and Floriculture,
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.

Abstract

A line x tester analysis involving 5 promising lines and 3 testers having broader genetic base were carried out to investigate the extent of heterosis for fruit yield and related horticultural traits in cucumber at CSK HPKV, Palampur during summer, 2003. The parents and their fifteen hybrid combinations were evaluated in a randomized block design along-with a standard check, Pusa Sanyog, replicated thrice for heterosis. AAUC-1 x K. Paprola (39.57%) and Sel. 75-1-10 x K. Paprola (51.74%) revealed maximum heterobeltiosis and maximum standard heterosis for marketable yield per plant, respectively. The desirable cross combinations Sel. 75-1-10 x k. Paprola, AAUC-2 x K. Paprola, AAUC -2 x Sel. 75-2-10 and AAUC -1 x K. Paprola were the top four cross combinations which showed high economic heterosis and heterobeltiosis. These desirable heterotic combinations can further be exploited for commercial cultivation or can be used in various breeding programmes for the improvement of fruit yield and related traits in cucumber.

Introduction

Cucumber, a member of family Cucurbitaceae is one of the most important off-season vegetable crops grown during rainy-season in hills of Himachal Pradesh for its tender fruits. It is recognized as a major cash crop in the mid-hills for the growers particularly during rainy season when it is difficult to grow cucumbers in the plains. There are many hybrids from the private sector which are in the market but lack desirable horticultural traits such as fruit shape and crispness. So there is a need to develop hybrids in cucumber having desirable horticultural and quality traits and to make available their seeds to the farmers at a reasonable price. Since, it is highly cross pollinated crop due to monoecious nature and exhibits high heterosis which suggests a great scope of improvement through heterosis breeding. Keeping this in view, the present investigation was conducted to generate information about nature and magnitude of heterosis for different economic characters by using line x tester analysis involving 5 lines and 3 testers. Although some information is available about heterosis in this crop but it is relevant to specific region, genetic material involved and environmental conditions.

Material and Methods

The experimental material for the present study comprised of five inbred lines of cucumber *viz.*, K-75, AAUC-2, AAUC-1, Sel. 75-1-10 and CHC-2, three testers *viz.*, Sel. 75-2-10, Poinsette and K. Paprola, their fifteen F_1 combinations. These were evaluated in completely randomized block design along-with a standard check, Pusa Sanyog, replicated thrice at the Vegetable Farm, CSK HPKV, Palampur during *kharif*, 2003. The plants were first raised in the poly-tubes (size 6x3) by sowing the seeds on 7th of March, 2003 inside the poly-house. These were then transplanted at 3 leaf stage in the open field on 9th of April, 2003, keeping inter and intra-row spacing of 1.5m and 0.5m, respectively. The observations were recorded on five competitive plants from each of the parents, standard check and crosses in each replication on fruit length (cm), fruit diameter (cm), average fruit weight (g), marketable fruits per vine, marketable yield per vine (kg), primary branches per plant, vine length and total soluble solids (%). The mean values were subjected to calculate heterosis over better parent and standard check.

Results and Discussion

The analysis of variance revealed significant differences among the genotypes for

**Department of Plant Breeding and Genetics, CSK HPKV, Palampur.*

all the characters studied (Table 1). On the basis of heterosis, a good number of crosses showed the presence of desirable heterotic response over better parent and standard check (Pusa Sanyog) for different characters (Table 2 & 3). Higher yield is the prime objective in any breeding programme. For marketable yield per vine, 13 and 12 cross combinations showed heterobeltiosis and economic heterosis, respectively. Maximum heterobeltiosis was shown by AAUC-1 x K. Paprola whereas the cross combination Sel. 75-1-10 x K. Paprola construed the maximum economic heterosis. So, these crosses can further be sorted out for their prudentiality and potentiality for yield increase. Fruit length and average fruit weight are the most important traits, which contribute towards yield. For fruit length, the crosses, k-75 x sel. 75-2-10 and aauc-2 x k. Paprola had the maximum respective heterobeltiosis and economic heterosis. Cross combinations Sel. 75-1-10 x Poinsette and aauc-1 x K. Paprola exhibited similar trends for fruit diameter.

Out of eight F_1s which showed heterobeltiosis for average fruit weight, Sel. 75-1-10 x K. Paprola resulted in maximum heterosis while AAUC-2 x Sel. 75-2-10 gave maximum economic heterosis out of the twelve significant economic heterotic hybrids.

Table 1. Analysis of variance for completely randomized block design

Sources of variation Traits df	Replications 2	Treatments 23	Error 46
Fruit length (cm)	0.1517	9.8534*	0.3821
Fruit diameter (cm)	0.0264	0.2692*	0.0167
Average fruit weight (g)	13.0833	3929.1520*	23.7899
Marketable fruits per vine	0.5120	10.4032*	0.2565
Marketable yield per vine (kg)	0.0443	1.3213*	0.0183
Number of primary branches per vine	0.0872	0.8341*	0.0436
Vine length (m)	0.0271	0.9278*	0.0169
Total soluble solids (%)	0.0328	0.1816*	0.0129

*Significant at 5% level of significance

Yield in cucumber is dependent primarily on fruit number and fruit weight (Bairagi *et al.*, 2002). The latter, however, is a function of time, which is under the control of grower. Therefore, improvement in a complex attribute like yield is possible and easier if progress is made through components like number of fruits per vine. For this trait, the cross combination AAUC-2 x K. Paprola revealed maximum heterobeltiosis and eleven f_1s displayed significant positive heterosis over their respective better parent. However, only six F_1s exhibited desirable heterosis over standard check, Pusa Sanyog and maximum standard heterosis was recorded in Sel. 75-1-10 x K. Paprola. This may be due to the gynoecious back ground of Pusa Sanyog, which bears more female flowers than monoecious combinations.

With regard to number of primary branches per plant, five crosses revealed significant positive heterobeltiosis while four crosses displayed desirable economic heterosis, being maximum in Sel. 75-1-10 x Sel. 75-2-10 and AAUC-2 x Poinsette, respectively. Five crosses each showed heterobeltiosis and economic heterosis for vine length being maximum in K-75 x K. Paporla and AAUC-2 x Sel. 75-2-10, respectively. Relatively higher TSS is desirable in cucumber which is associated with better taste and quality. Four over better parent and five over standard check revealed significant positive heterosis and maximum was observed in AAUC-1 x Poinsette and CHC-2 x Poinsette, respectively.

From results, an appreciable amount of heterosis and heterobeltiosis was evident for various characters. This indicates the amount of genetic diversity of the parents involved in the crosses in determining the heterotic effects. The low and negative heterosis for some characters in different characters may be due to the presence of large epistatic gene effects or due to incomplete dominant gene effects. The desirable cross combinations Sel. 75-1-10 x K. Paprola, AAUC-2 x K. Paprola, AAUC-2 x Sel. 75-2-10 and AAUC-1 x K. Paprola were the top four cross combinations which showed which showed high economic heterosis and heterobeltiosis. The highest heterosis recorded in the best performing

hybrids could be attributed to its increased number of fruits per plant, average fruit weight and fruit length. The findings of the present investigation are in close conformity with the results of Dogra *et al.* (1997), Bairagi *et al.* (2001 & 2002), Munshi *et al.* (2005) and Pandey *et al.* (2005).

The desirable cross combinations offer a better scope of commercial exploitation by hybrid production by inducing femaleness with the help of growth regulators to minimize the cost of hybrid seed production provided the effect of growth regulators is well understood before initiating conversion of these lines to the gynoecism. The economic heterosis for fruit yield to the extent of 52% offers a good scope for heterosis breeding in this crop.

Besides hybrid seed production, these crosses can be further used to produce bi-parental progenies to get superior segregants which may be handled through pedigree methods of breeding for varietal improvement.

Table 2. Per cent heterosis over better parent (BP) and standard check (SC) for different characters in cucumber

Cross combination	Fruit length		Fruit diameter		Average fruit weight		Marketable fruits/ plant	
	BP	SC	BP	SC	BP	SC	BP	SC
K-75 x Sel. 75-2-10	11.90*	-3.71	-6.51*	-5.18*	4.48*	-1.03	3.85	1.06
K-75 x Poinsette	10.26*	8.27*	-4.93*	-3.57	4.64*	-0.88	17.82*	14.66*
K-75 x K. Paprola	11.23*	10.92*	-1.14	8.39*	13.00*	16.00*	4.60	1.79
AAUC-2 x Sel. 75-2-10	-10.02*	9.68*	4.33*	3.21	3.43*	37.95*	25.62*	-0.57
AAUC-2 x Poinsette	-9.28*	10.58*	0.00	-1.07	-16.53*	11.33*	36.73*	8.22*
AAUC-2 x K. Paprola	-1.99	19.47*	-0.81	8.75*	-10.67*	19.15*	46.30*	15.80*
AAUC-1 x Sel. 75-2-10	-10.41*	9.45*	-3.63*	-0.54	-9.70*	19.17*	26.64*	-0.90
AAUC-1 x Poinsette	-3.78	17.56*	-2.42	0.71	-8.10*	21.28*	35.44*	4.56
AAUC-1 x K. Paprola	-3.82	17.50*	2.44	12.32*	-0.78	30.95*	40.49*	2.85
Sel. 75-1-10 x Sel. 75-2-10	-4.56	0.00	6.11*	2.32	0.40	4.22*	9.84*	20.85*
Sel. 75-1-10 x Poinsette	-3.38	1.24	7.96*	4.11*	-3.64*	0.02	-6.07*	3.34
Sel. 75-1-10 x K. Paprola	2.69	7.60*	-5.70*	3.39	19.77*	24.32*	10.88*	21.99*
CHC-2 x Sel. 75-2-10	5.88*	8.44*	4.56*	3.21	10.16*	11.11*	20.28*	12.54*
CHC-2 x Poinsette	9.84*	12.49*	0.73	-1.07	15.34*	16.33*	11.23*	4.07
CHC-2 x K. Paprola	8.63*	11.25*	-3.75*	5.54*	17.58*	20.70*	-11.40*	-17.10*
SE ±	0.505	0.505	0.106	0.106	3.982	3.982	0.414	0.414

*Significant at 5% level of significance

Table 3. Per cent heterosis over better parent (BP) and standard check (SC) for different characters in cucumber (*contd...*)

Cross combination	Marketable yield/ plant		Primary branches/ vine		Vine length		TSS	
	BP	SC	BP	SC	BP	SC	BP	SC
K-75 x Sel. 75-2-10	8.27*	0.00	20.64*	-2.31	-10.96*	-22.62*	-13.77*	-11.83*
K-75 x Poinsette	23.31*	13.89*	18.50*	-4.03	13.26*	-11.01*	-12.67*	-10.70*
K-75 x K. Paprola	27.82*	18.06*	3.20	-16.43*	24.92*	19.35*	-13.77*	-11.83*
AAUC-2 x Sel. 75-2-10	29.51*	37.15*	1.82	12.97*	1.97	23.51*	1.61	6.48*
AAUC-2 x Poinsette	13.77*	20.49*	12.47*	24.78*	-18.43*	-1.19	-1.88	2.82
AAUC-2 x K. Paprola	30.49*	38.19*	-15.06*	-5.76	-9.82*	9.23*	-10.48*	-6.20*
AAUC-1 x Sel. 75-2-10	22.66*	18.40*	-19.46*	3.75	-11.32*	0.30	8.62*	6.48*
AAUC-1 x Poinsette	31.65*	27.08*	-12.08*	13.26*	-9.47*	2.38	10.56*	6.20*
AAUC-1 x K. Paprola	39.57*	34.72*	-7.16	19.60*	6.58*	20.54*	1.17	-2.82
Sel. 75-1-10 x Sel. 75-2-10	10.33*	26.04*	27.30*	7.49	-13.40*	-17.26*	6.90*	4.79
Sel. 75-1-10 x Poinsette	-9.42*	3.47	2.39	-13.54*	-21.81*	-25.30*	10.09*	7.61*
Sel. 75-1-10 x K. Paprola	32.83*	51.74*	25.26*	5.76	21.18*	15.77*	1.73	-0.56
CHC-2 x Sel. 75-2-10	32.72*	25.35*	-13.49*	-5.76	-9.25*	-21.13*	0.52	9.01*
CHC-2 x Poinsette	28.31*	21.18*	-8.20	0.00	18.68*	-9.23*	-5.71*	2.25
CHC-2 x K. Paprola	5.88	0.00	-8.20	0.00	-6.54*	-10.71*	-14.29*	-7.04*
SE ±	0.110	0.110	0.171	0.171	0.106	0.106	0.093	0.093

*Significant at 5% level of significance

VIR SOFTECH

References

Bairagi SK, Singh DK and Ram HH 2001. Diallel analysis for combining ability in cucumber (*Cucumis sativus* L.). Prog. Hort. **33** (2): 178-183.

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

Dogra BS, Rastogi KB, Korla BN and Sharma HR 1997. Heterosis and combining ability for yield and quality characters in cucumber (*Cucumis sativus* L.). J. Hill Res. **10** (1): 9-42.

Munshi AD, Kumar R and Panda B 2005. Heterosis for yield and its components in cucumber (*Cucumis sativus* L.). Veg. Sci. **32** (2): 133-135.

Pandey S, Singh B, Singh M and Rai M 2005. Heterosis in cucumber (*Cucumis sativus* L.). Veg. Sci. **32** (2): 143-145.