

## Original Research Article

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## Heterosis Studies for Yield and Quality Traits in Cucumber (*Cucumis sativus* L.)

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### ABSTRACT

Cucumber (*Cucumis sativus* L.) is the most preferred versatile fruit consumed in various ways, salad ingredient, pickles, deserts fruit and as a cooked vegetable, Crop improvement in cucumber has gain lot of importance compared to other cucurbit vegetables. Therefore the present investigation has been carried out to know these extend of heterosis for yield parameters and quality parameters. The experimental materials consisted of five *Lines* and five *Testers* which were collected from the germplasms maintained by the Department of Vegetable Science, College of Horticulture, UHS Campus, GKVK, and Bengaluru. Twenty five  $F_1$ 's were developed by crossing them in Line X Tester mating design. The IIHR-285, IIHR-341, IIHR-304, Green Long, Pondicherry-1, were used as lines and the Poinsette, Phule Shubhangi, Punjab Naveen, Pusa Uday, Kerala-1 were used as testers based on their yield potentiality Observation from five competitive plants was recorded on various characters viz number of fruits per plant, fruit diameter (cm), fruit length (cm), average fruit weight (g), fruit yield per plant (kg). shelf life (days), cavity thickness (cm), flesh thickness (cm), Rind thickness (mm), Analysis of variance was carried out s for all the characters observed and population mean for each of the replication was used for analysis. The variance due to genotypes (crosses and parents) was highly significant (at  $p=0.01$ ) for all the traits studied viz number of fruits per vine, fruit length (cm), fruit diameter (cm), average fruit weight (g), fruit yield per plant(kg), shelf life (days),cavity thickness (cm), flesh thickness (cm) and rind thickness (mm). The hybrids viz Green long  $\times$  Poinsette, Green long  $\times$  Pusa Uday, Pondicherry 1  $\times$  Punjab Naveen were found as best for yield per vine, for fruit length, average fruit weight, number of fruits per vine over the check Chitra.

#### Keywords

Cucumber  
*Cucumis sativus* L.,  
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### Introduction

Cucurbit” is a term coined by Liberty Hyde Bailey for cultivated species consisting of 118 genera Cucumber (*Cucumis sativus* L.) is one of the most popular vegetable of the family

Cucurbitaceae. Cucumber is distinct from the other *Cucumis* species as it has got seven pairs of chromosomes  $2n=2x=14$  a true diploid. India is the centre of origin of many Cucurbitaceous vegetables, where the Cucurbits are capable of thriving and

performing well even under the hot summer. The demand for the hybrids in cucumber with good quality is increasing along with high yield. Cucumber is a suitable crop for the development of hybrids of commercial importance due to monoecious sex form which eliminates emasculation and large number of seeds per cross, make it more economical. Heterosis breeding has been recognized as practical tool in providing breeder a means for increasing yield and other economic traits. The hybrid vigour or the superiority of the F<sub>1</sub> hybrids over parents may be manifested in terms of high productivity, uniformity in improved qualities, built in resistance, environmental adaptations, earliness etc. However it never happens that each hybridization is accompanied by manifestation of hybrid vigour. Only certain pair of parents gives heterotic progeny. Therefore exploitation of heterosis for commercial cultivation with high productivity, uniformity and fruit quality has become essential. Hence, the present study was undertaken to find out good and most reliable hybrids for high yield and quality.

### **Materials and Methods**

The experimental materials consisted of five Lines and five Testers of cucumber collected from the Department of Vegetable Science, College of Horticulture, UHS Campus, GKVK, and Bengaluru. Twenty five F<sub>1</sub>'s were developed by crossing them in Line X Tester mating design. The IIHR-285, IIHR-341, IIHR-304, Green Long, Pondicherry-1, were used as lines and the Poinsette, Phule Shubhangi, Punjab Naveen, Pusa Uday, Kerala-1 were used as testers based on their yield potential. The study was undertaken at PG Research Block of the Department of Vegetable Science, College of Horticulture, Bengaluru under open field condition by following Randomized Complete Block Design with two replications in the spacing of

1.5 m×1 m. Land preparation. Nursery raising, transplanting and intercultural operation was followed as per the recommendation of package of practices of UHS Bagalkot. Observation from five competitive plants were used to record the observation on various characters viz number of fruits per plant, fruit diameter (cm), fruit length (cm), average fruit weight (g), fruit yield per plant (kg). shelf life (days), cavity thickness (cm), flesh thickness (cm), rind thickness (mm). Analysis of variance was carried out separately for all the characters using mean of the replications.

### **Results and Discussion**

Number of fruits is important parameter which directly contributes to the yield. The more number of fruits was recorded in the parents like IIHR 341 (7.15) followed by Poinsette (6.75). Hayes and Jones (1916) reported the first generation crosses in cucumber frequently exhibited the high parent heterosis due to increased fruit number per plant. The crosses viz., IIHR 341 × Phule Shubhangi (8.15), IIHR 341 × Punjab Naveen (7.40), IIHR 341 × Kerala-2 (7.25), Pondicherry 1 × Punjab Naveen (7.15), IIHR 341× Poinsette (6.6) exhibited the significant standard heterosis. The crosses like viz., IIHR 341 × Phule Shubhangi (64.65%), IIHR 341× Poinsette (53.54 %), IIHR 341 × Punjab Naveen (49.49 %), IIHR 341 × Kerala-2 (46.46 %), Pondicherry 1 × Punjab Naveen (44.44 %) exhibited the significant standard heterosis over the check. Significant and desirable heterosis in aforesaid crosses is due to dominance and dominance x dominance type of interaction, Singh *et al.*, (2012). Higher heterobeltiosis for number of fruits was observed in Pondicherry 1 × Punjab Naveen (31.19 %), Green Long × Kerala -2 (18.69 %) similar result was reported by Airina *et al.*, (2013) and Singh *et al.*, (2015). For the fresh consumption less fruit diameter is preferred (Arya and Singh, 2014). Hence,

negative direction of heterosis consider to be an desirable. Among parent lesser fruit diameter is observed in Punjab Naveen (4.10 cm) with respect to crosses lesser fruit diameter was observed in IIHR 304 × Kerala - 2 (4.15). Most of the crosses exhibited the significant positive heterosis for this trait it is in accordance with the research findings of Kumar *et al.*, (2010). IIHR 304 × Kerala -2 exhibited the significant negative heterosis over better parent (-19.42%) and over the check Chitra (-19.42%). It is in line with the research findings of Jat *et al.*, (2015) and Singh *et al.*, (2015) in cucumber. Heterosis in positive direction is desirable for fruit length, which is an important traits, contribute towards yield and Highest significant positive heterosis was recorded in the crosses Green long × Pusa Uday (41.94 %), Green long × Poinsette (38.31 %), Green Long × Punjab Naveen (30.37 %) over the check it is in line with Jat *et al.*, (2015) in cucumber. Fruit weight is an important component which ultimately results in higher fruit yield. The maximum average fruit weight was recorded in Pondicherry- 1 (515.50 g) among parents and Pondicherry- 1 × Phule Shubhangi (747.75 g) with respect to hybrids. The heterosis in positive direction is desirable for this trait. Positive heterobeltiosis was reported by Airina *et al.*, (2013) and Singh *et al.*, (2015) in cucumber. Similarly, in this study significant positive heterobeltiosis was recorded in Green long × Phule Shubhangi (39.51 %), Pondicherry 1 × Poinsette ( 39.16 % ), Green Long × Pusa Uday (38.16 %), Pondicherry 1 × Punjab Naveen (35.59 %), Pondicherry 1 × Pusa Uday (32.61 %). More number of crosses exhibited the significant Positive standard heterosis over check Chitra and maximum was recorded in Pondicherry 1 × Phule Shubhangi (46.52 %). It is in line with the findings of Dogra *et al.*, (2011) Arya and Singh (2014) and Jat *et al.*, (2015) in cucumber. Increase in the fruit yield per vine is an important criteria to increase the

productivity. Pondicherry- 1 (2.68) and Pondicherry- 1 × Punjab Naveen (4.65 kg) exhibited the maximum yield potential among parents and hybrids respectively. Hanchinamani and Patil (2009) reported that the maximum yield attributed to increase in average fruit weight and total number of fruits per plant. For yield and yield attributing characters heterosis in positive direction is desirable. Only 16 crosses exhibited the significant standard heterosis over the check Chitra. Among 25 crosses, 13 crosses exhibited the significant positive heterobeltiosis and maximum was observed in Green Long × Pusa Uday (68.22 %). Similar results were reported by Airina *et al.*, (2013) and Singh *et al.*, (2015). The cross Pondicherry- 1 × Punjab Naveen (55.79 %) exhibited the significant positive heterosis over the check. It is in line with the research findings of Arya and Singh (2014) and Jat *et al.*, (2015) in cucumber.

For fruit shelf life positive heterosis is desirable in cucumber. Among parents maximum shelf life was observed in Pondicherry-1 (6.10) and less shelf life was observed in IIHR 285 (4.25). Low genotypic and phenotypic coefficients of variation were recorded for fruit moisture per cent. Most of the crosses under study show the positive heterosis it is in line with the findings of Pushpalatha *et al.*, (2015) in cucumber. The negative heterosis is desirable for fruit cavity thickness in cucumber. Among parents maximum cavity thickness was observed in Pondicherry-1 (2.24) and thin cavity was observed in IIHR 341 (2.02). Most of the crosses under study show the positive heterosis it is in line with the findings of Vishwanatha *et al.*, (2003) in muskmelon. The crosses IIHR 285 × Poinsette (-16.43 %) exhibited the negative direction heterosis over the commercial check which is desirable. Similar result reported by Choudary *et al.*, (2003) (Table 1–3).

**Table.1** Analysis of variance (mean sum of squares) of line × tester analysis for various yields and quality characters in cucumber

Sl. No.	Character	Replications	Geno types	Parents	Parents vs Crosses	Crosses	Lines	Testers	Line × Tester	Error
	<b>Degree of freedom</b>	1	34	9	1	24	4	4	16	34
1	Number of fruits per plant	0.192	2.04**	0.92**	0.23 NS	2.54**	7.29*	0.16 NS	1.95**	0.07
2	Fruit diameter (cm)	0.19	0.78**	0.32**	6.77**	0.71**	3.21**	0.04 NS	0.25*	0.09
3.	Fruit length (cm)	0.684	20.55**	4.38**	241.05**	17.42**	82.62**	5.05 NS	4.21**	0.23
4.	Average fruit weight (g)	92.20	48485.31**	28037.32**	141301.39**	52285.98 **	231923.90 **	19514.9	15569.3**	62.78
5.	Fruit yield per plant (kg)	0.03	2.11**	0.42 NS	15.92 NS	2.17*	9.71**	1.92**	0.35 NS	0.89
6.	Shelf life (days)	1.76	1.38**	0.76 NS	12.17 NS	1.16*	5.03**	0.87*	0.26 NS	0.50
7.	Cavity thickness (cm)	0.06	0.04**	0.01*	1.23**	0.003 NS	0.006 NS	0.002 NS	0.003 NS	0.006
8.	Flesh thickness (cm)	0.02	0.14**	0.26**	0.19**	0.10 **	0.07 NS	0.19 NS	0.08 ***	0.01
9.	Rind thickness (mm)	0.001	0.009**	0.012**	0.005**	0.009**	0.023**	0.009*	0.002**	0.00

\*and \*\* indicate significance of values at p=0.05 and p=0.01, respectively, NS: Non significant

**Table.2** Per se performance of parents and crosses for yield and fruit quality parameters in cucumber

Sl. No.	Genotypes	Number of fruits per plant	Fruit diameter (cm)	Fruit length (cm)	Avg. fruit weight (g)	Fruit yield per plant (kg)	Fruit yield per ha (t)	Shelf life (days)	Cavity thickness (cm)	Flesh thickness (cm)	Rind thickness (mm)
1.	IIHR 285 × Poinsette	4.07	4.35	18.35	256.35	1.35	9.00	4.10	1.75	1.85	0.71
2.	IIHR 285 × Phule Shubhangi	4.25	4.70	19.25	260.60	1.40	9.33	5.70	1.86	1.60	0.74
3.	IIHR 285 × Punjab Naveen	5.20	5.00	20.36	386.05	1.59	10.60	5.20	1.85	1.65	0.91
4.	IIHR 285 × Pusa Uday	7.05	4.50	21.75	415.15	2.80	18.67	4.65	1.86	1.55	0.74
5.	IIHR 285 × Kerala-2	6.07	5.25	20.75	520.65	3.10	20.67	5.65	1.84	1.70	0.77
6.	IIHR 341 × Poinsette	6.60	5.30	18.13	292.75	3.10	20.67	5.25	1.78	1.60	0.76
7.	IIHR 341 × Phule Shubhangi	8.15	5.50	24.10	278.80	2.75	18.33	5.35	1.90	1.70	0.69
8.	IIHR 341 × Punjab Naveen	7.40	5.35	20.36	403.05	3.45	23.00	5.35	1.82	1.85	0.72
9.	IIHR 341 × Pusa Uday	7.10	5.35	22.05	522.30	3.15	21.00	5.75	1.88	1.35	0.73
10.	IIHR 341 × Kerala-2	7.25	4.85	21.65	358.15	3.65	24.33	6.30	1.88	1.95	0.75
11.	IIHR 304 × Poinsette	6.35	5.00	18.70	293.65	2.00	13.33	5.70	1.87	1.45	0.75
12.	IIHR 304 × Phule Shubhangi	7.15	4.36	19.35	327.05	1.75	11.67	5.50	1.87	1.35	0.75

13.	IIHR 304 × Punjab Naveen	5.30	5.05	20.04	250.80	1.55	10.33	6.15	1.86	1.25	0.75
14.	IIHR 304 × Pusa Uday	6.20	4.21	19.93	369.30	2.75	18.33	5.45	1.87	1.55	0.75
15.	IIHR 304 × Kerala -2	4.75	4.15	20.70	515.70	2.35	15.67	6.20	1.90	1.85	0.75
16.	Green Long × Poinsette	7.50	4.80	27.87	557.05	4.65	31.00	6.70	1.88	1.85	0.77
17.	Green Long × Phule Shubhangi	5.30	5.30	24.75	670.70	2.70	18.00	6.80	1.81	1.40	0.78
18.	Green Long × Punjab Naveen	5.45	5.00	26.27	601.75	3.35	22.33	6.95	1.80	1.30	0.78
19.	Green Long × Pusa Uday	6.35	5.60	28.60	698.65	4.63	30.87	7.15	1.82	1.50	0.91
20.	Green Long × Kerala -2	6.35	5.40	25.06	599.20	4.05	27.00	7.15	1.79	1.60	0.94
21.	Pondicherry- 1 × Poinsette	3.20	6.40	23.67	717.65	2.25	15.00	6.00	1.88	2.00	0.95
22.	Pondicherry- 1 × Phule Shubhangi	5.20	5.90	24.01	747.75	3.95	26.33	5.75	1.88	1.89	0.78
23.	Pondicherry- 1 × Punjab Naveen	7.15	5.95	25.25	699.25	4.50	30.00	6.15	1.88	1.25	0.79
24.	Pondicherry- 1 × Pusa Uday	5.15	6.00	24.33	683.85	3.75	25.00	6.70	1.84	1.35	0.79
25.	Pondicherry- 1 × Kerala- 2	5.25	5.85	22.65	547.65	4.40	29.33	6.55	1.89	1.55	0.81
<b>Lines</b>											
26.	IIHR 285	6.05	4.11	16.40	202.75	2.05	13.67	4.25	2.05	2.15	0.69
27.	IIHR 341	7.15	4.29	16.50	206.10	2.10	14.00	4.65	2.02	2.37	0.72
28.	IIHR 304	5.25	4.32	16.20	344.80	2.25	15.00	4.55	2.21	1.85	0.69
29.	Green Long	5.25	4.55	19.01	480.75	2.55	17.00	5.85	2.32	1.59	0.70
30.	Pondicherry- 1	5.35	5.05	20.66	515.70	2.68	17.87	6.10	2.24	1.65	0.94
<b>Testers</b>											
31.	Poinsette	5.10	4.20	18.21	330.70	1.25	8.33	4.50	2.12	1.22	0.71
32.	Phule Shubhangi	5.25	4.15	19.24	377.90	1.75	11.67	4.90	2.11	1.85	0.77
33.	Punjab Naveen	5.45	4.10	18.15	376.75	1.60	10.67	4.65	2.04	1.71	0.82
34.	Pusa Uday	5.30	4.85	19.55	405.70	1.58	10.53	5.45	2.15	1.28	0.83
35.	Kerala-2	5.35	5.15	18.18	402.85	1.63	10.87	5.15	2.17	1.45	0.87
<b>Check</b>											
36.	Chitra	5.95	5.15	20.15	510.35	3.00	20.00	5.50	2.1	1.45	0.7
	S.Em±	0.26	0.30	0.48	7.92	0.94	4.34	0.70	0.08	0.11	0.01
	CD at 5%	0.55	0.62	1.01	16.35	1.95	8.64	1.46	0.16	0.24	0.02
	CD at 1%	0.74	0.84	1.36	22.16	2.65	11.48	1.98	0.22	0.35	0.03

**Table.3** Heterosis (%) over better parent, the best parent and the commercial check for flesh thickness, rind thickness and fruit yield per plant (kg)

Sl. No.	Cross	Flesh thickness (cm)			Rind thickness (mm)			Fruit yield per plant (kg)		
		BP	BTP	CC	BP	BTP	CC	BP	BTP	CC
1.	IIHR 285 × Poinsette	-13.95	15.99**	27.59**	-8.39**	-3.40	-0.70	-34.15	-47.06**	-55.16**
2.	IIHR 285 × Phule Shubhangi	-25.58**	0.31	10.34	-11.38**	0.68	3.50	-31.95	-45.29**	-53.26**
3.	IIHR 285 × Punjab Naveen	-23.26**	3.45	13.79	5.85**	23.13**	26.57**	-22.68	-37.84**	-47.26**
4.	IIHR 285 × Pusa Uday	-27.91**	-2.82	6.90	-4.52*	0.68	3.50	36.59**	9.80	-6.60
5.	IIHR 285 × Kerala-2	-20.93	6.58	17.24*	-7.78**	4.76*	7.69**	51.22**	21.57	3.53
6.	IIHR 341× Poinsette	-32.63**	0.31	10.34	-10.53**	4.08	6.99**	47.62**	21.57	3.53
7.	IIHR 341 × Phule Shubhangi	-28.42**	6.58	17.24*	-10.32**	-5.44**	-2.80*	30.95	7.84	-8.30
8.	IIHR 341 × Punjab Naveen	-22.11**	15.99*	27.59**	-14.37**	2.72	0.01	64.29**	35.29**	13.30*
9.	IIHR 341 × Pusa Uday	-43.16**	-15.36*	-6.90	-14.62**	-0.68	2.10	50.00**	23.53**	5.30
10.	IIHR 341 × Kerala-2	-17.89	22.26**	34.48**	-3.23	2.04	4.90*	63.81**	43.14**	21.60**
11.	IIHR 304 × Poinsette	-21.62**	-9.09	0.00	-9.58**	2.72	5.59**	-11.11	-21.57	-33.33**
12.	IIHR 304 × Phule Shubhangi	-27.03**	-15.36*	-6.90	-11.70**	2.72	5.59**	-22.22	-31.37**	-41.60**
13.	IIHR 304 × Punjab Naveen	-32.43**	-21.63**	-13.79	-3.87*	1.36	4.20**	-31.11	-39.22**	-48.30**
14.	IIHR 304 × Pusa Uday	-16.22	-2.82	6.90	-10.18**	2.04	4.90**	22.22	7.84	-8.30
15.	IIHR 304 × Kerala -2	0.00	15.99*	27.59**	-9.94**	4.76*	7.69**	4.44	-7.84	-21.60**
16.	Green Long × Poinsette	15.99*	15.99*	27.59**	-0.65	4.76*	7.69**	68.22**	61.57**	55.79**
17.	Green Long × Phule Shubhangi	-24.32**	-12.23	-3.45	-5.99**	6.80**	9.79**	5.88	5.88	-10.00
18.	Green Long × Punjab Naveen	-24.20**	-18.50*	-10.34	-8.19**	6.80**	27.27**	31.37**	31.37**	11.60
19.	Green Long × Pusa Uday	-5.96	-5.96	3.45	0.55	23.81**	31.47**	66.47**	66.47**	54.30**
20.	Green Long × Kerala -2	0.31	0.31	10.34	3.87*	27.89**	32.87**	58.82**	58.82**	35.53**
21.	Pondicherry- 1 × Poinsette	21.21**	25.39**	37.93**	4.97**	29.25**	9.79**	-11.76	-11.76	-25.26**
22.	Pondicherry- 1 × Phule Shubhangi	2.16	18.5*	30.34**	1.29	6.80**	10.43**	47.66**	54.90**	31.32**
23.	Pondicherry- 1 × Punjab Naveen	-27.11**	-21.63**	-13.79	-5.39**	7.48**	11.19**	55.79**	62.35**	50.47**
24.	Pondicherry- 1 × Pusa Uday	-18.18	-15.36*	-6.90	-7.02**	8.16**	12.59**	47.06**	47.06**	35.89**
25.	Pondicherry- 1 × Kerala 2	-6.06	-2.82	27.59**	-8.00**	9.52**	15.38**	4.47	9.80	-6.60
	S.Em+_	0.11	0.11	0.24	0.01	0.01	0.01	0.94	0.94	0.94
	CD at 5%	0.24	0.24	0.32	0.02	0.02	0.02	1.95	1.95	1.95
	CD at 1%	0.32	0.32	27.59**	0.03	0.03	0.03	2.65	2.65	2.65

\*and \*\* indicate significance of values at p=0.05 and 0.01, respectively.

BP- Heterosis over better parent

BTP- Heterosis over the best parent (Green Long)

CC- Heterosis over the commercial check (Chitra)

For flesh thickness, out of 25 crosses, 22 crosses over better parent, two crosses over the best parent and 10 crosses over the commercial check exhibited positive and significant heterosis. The cross Pondicherry-1 × Poinsette exhibited 21.21 % of heterosis over better parent. The cross Pondicherry-1 × Poinsette showed 37.93 % of heterosis over the commercial check and is very low as compared to 144.60 per cent in musk melon reported by Vishwanath (2003).

For fruit rind thickness negative heterosis is desirable in cucumber which is reported by Pandey *et al.*, (2005). Among parents maximum rind thickness was observed in Pondicherry 1 (0.94) and thin rind was observed in IIHR 304 (0.64). Most of the crosses under study shows the positive heterosis it is in line with the findings of Narasannavar *et al.*, (2014) in ridge gourd. The crosses IIHR 341 × Pusa Uday (-14.62%) exhibited the heterobeltosis in negative direction which is desirable. Similar result reported by Pandey *et al.*, (2005).

In conclusion, the magnitude of heterosis over the standard check (Chitra) for important traits viz number of fruits per plant -17.68 to 44.44, fruit length -10.05 to 41.94, average fruit weight -45.37 to 46.52 and fruit yield per plant -53.16 to 55.79. Green long × Poinsette, Green long × Pusa Uday, Pondicherry 1 × Punjab Naveen these hybrids exhibited the maximum significant standard heterosis over the check (Chitra) for yield per vine and same cross combination exhibited maximum significant standard heterosis for fruit length, average fruit weight, number of fruits per vine over standard check. The results indicated the importance of heterosis breeding for the effective utilization of non-additive genetic variance which had a predominant role in the improvement of yield and quality of cucumber.

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