Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6047

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (6):** 1494-1498 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Heterosis Studies for Growth, Fruit Yield and Yield Attributing Characters in Chilli (*Capsicum annuum* L. var. *acuminatum* Fingerh.) Under Hilly Region of Bharsar, Uttarakhand

Thilak, J. C.,[1*] Pant, S. C.,[2] Paliwal, A.,[3] Singh, R.[4] and Megharaj, K. C.,[5]

[*1]M.Sc Scholar, [2]Assistant Professor, [3]Assistant Dean Student Welfare, [4]M.Sc Scholar,
Department of Vegetable Science, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri garhwal, Uttarakhand - 246123, India

[5]Ph.D Scholar, Department of Vegetable Science, College of Horticulture, Bagalkot, India

*Corresponding Author E-mail: thilakjc849@gmail.com

Received: 30.11.2017 | Revised: 26.12.2017 | Accepted: 29.12.2017

ABSTRACT

The present investigation entitled "Heterosis and Combining Ability Studies for Yield and other Horticultural Traits in Chilli (Capsicum annuum L. var. acuminatum Fingerh.)" was carried out at Vegetable Research and Demonstration Block of Uttarakhand University of Horticulture and Forestry, Bharsar, during 2016-2017. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Six diverse chilli lines were crossed in a diallel fashion (excluding reciprocals) to obtain fifteen cross combinations to study heterosis and combining ability for yield and other horticultural traits. Significant heterobeltiosis was observed in desirable direction for all traits. Similarly, significant increase or decrease heterosis over check (Arka Harita) was observed for all the traits under study. Nine crosses over better parent and three crosses over the commercial check exhibited positive and significant heterosis for yield per plant. The cross Byadgi Dabbi × G-4 exhibited maximum heterosis over the better parent and Byadgi Dabbi × Arka Lohit over standard check. Hybrids performed better in yield and other horticultural traits that opened the way for further evaluation and release as hybrids. Hence, Byadgi Dabbi x G-4, Byadgi Dabbi × Arka Lohit and Byadgi Kaddi x Arka Lohit can be recommended for commercial cultivation after multi-location testing.

Key words: *Heterosis, Chilli, Yield, Horticultural traits*

INTRODUCTION

Chilli (*Capsicum annuum* L. var. *acuminatum* Fingerh.) (2n = 24) is a member of the family Solanaceae, which has about 90 genera and 2000 species. The chilli is unique in its character being used as both a vegetable and a spice. They provide pungency, flavour and colour to foods. The genus *Capsicum* most likely originated in arid regions of the Andes Mountains (Peru and Bolivia) and then migrated to tropical regions of the America.

Cite this article: Thilak, J.C., Pant, S.C., Paliwal, A., Singh, R. and Megharaj, K.C., Heterosis Studies for Growth, Fruit Yield and Yield Attributing Characters in Chilli (*Capsicum annuum* L. var. *acuminatum* Fingerh.) Under Hilly Region of Bharsar, Uttarakhand., *Int. J. Pure App. Biosci.* **5(6):** 1494-1498 (2017). doi: http://dx.doi.org/10.18782/2320-7051.6047

Whereas, primary centre of the species *Capsicum annuum* is believed to be Mexico and with secondary centers in Guatemala and Bulgaria[9]. Due to low productivity and high demand of chilli in Uttarakhand, it is important to develop high yielding and suitable hybrids to boost up the production. The reasons for low yield are, growing of low yielding cultivars. Therefore, exploitation of heterosis is in need. Therefore, the present research under taken with an objective of studying the extent of heterosis in different crosses and their utilization in crop improvement programme.

MATERIALS AND METHODS

The experimental materials comprised of six diverse parents *viz.*, Byadgi Dabbi, Byadgi Kaddi, Arka Lohit, Arka Suphal, G-4 and Pant C-1 along with its 15 F_1 hybrids generated by half-diallel in all possible combinations excluding reciprocals during 2016-2017. Arka Harita used as standard check. The experiment was laid out in randomized block design with three replications at the Vegetable Research and Demonstration Block, UUHF, Bharsar, Uttarakhand (India). Each plot consisted of 8 plants. Inter and intra row spacing was kept 60 and 45 cm, respectively. The observations were recorded on five randomly selected plants from each treatment and replications for growth, fruit yield and yield attributing characters *viz.*, Plant height (cm), Number of primary branches per plant, Stem girth (cm), Days to 50 per cent flowering (days), Days to first fruit harvesting (days), Fruit length (cm), Fruit diameter (cm), Average fruit weight (g), Stalk length (cm), Stalk weight (gm), Number of fruits per plant, Yield per plant (Kg) and Yield per plot (Kg). Heterosis expressed as per cent increase or decrease in hybrids (F_1) over better parent (BP) and standard check (SC) values in desirable direction was calculated using the following formula.

Heterosis over better parent (BP) =

$$\frac{\bar{F}_1 - \overline{BP}}{\overline{BP}} \times 100$$

Increase/decrease over check (c) =

$$\frac{\bar{F}_1 - \bar{C}}{\bar{C}} \times 100$$

RESULTS AND DISCUSSION

For plant height, the highest heterosis over better parent was recorded in the cross viz., Byadgi Dabbi × Pant C-1 (29.57%), Byadgi Dabbi × Arka Lohit (14.81%), Byadgi Dabbi × Byadgi Kaddi (11.17%), while maximum heterosis over standard check was recorded Byadgi Dabbi × Pant C-1 (22.90%) and Byadgi Kaddi x Pant C-1 (8.90%). The results are in conformity with Krishnamurthy *et al.*[7].Nine best cross combinations exhibited high heterotic effects over check for the character number of primary branches per plant were Arka Lohit × Pant C-1 (18.42%), G-4 × Pant C-1 (16.92%), Byadgi Dabbi × Pant C-1 (11.99%) and Byadgi Dabbi × G-4 (6.21%), Byadgi Kaddi x Pant C-1 and Arka Suphal x G-4 (5.14%), Arka Lohit x G-4(4.50%), Arka Lohit x Arka Suphal (3.85%) and Arka Suphal x Pant C-1(3.64%). The findings are in conformity with that by Karthik *et al.*[5].The best cross combination exhibiting high heterotic effects over better parent and standard check for the character plant stem girth was Byadgi Kaddi × Arka Suphal (6.88% and 7.41% respectively). Similar positive heterosis confirmative of results reported by Reddy *et al.*[8].Earliness is one of the most desirable character for chilli was indicated by days required for 50% flowering and days to first fruit harvesting and the crosses with negative significant heterosis were considered as desirable for this trait. Out of fifteen crosses the best results were obtained from the cross Byadgi Kaddi × Pant C-1(66.71) for days to 50% flowering which was statistically at par with Byadgi Dabbi × Byadgi Kaddi (67.83 days) and Byadgi Dabbi × Arka Suphal (69.26 days). for days to first fruit harvesting. Early flowering in chilli hybrids due to negative heterotic effect to a considerable amount have been reported earlier Dejan *et al.*[2].For fruit length the cross Byadgi Dabbi × Byadgi Kaddi (9.92 cm), showed maximum fruit length followed by Byadgi Kaddi x G-4(9.08cm) and Byadgi Kaddi x Pant C-1(9.04 cm), while minimum fruit length was seen in the cross Arka Lohit x Arka Suphal(5.20cm). The finding of Shankarnag *et al.*[10] also supported

the above results.The best cross showing highest heterotic effect over better parent for the character fruit diameter was Byadgi Kaddi x Pant C-1 (32%) followed by Arka Suphal x Pant C-1 (28.89%) and Arka Lohit x Pant C-1 (11.56%). The crosses proved better for the character over standard check were Arka Lohit x Pant C-1 (83.47%), Arka Lohit x Arka Suphal (66.12%) and Arka Lohit × G-4 (61.98%). Similar result was found by Ajjappalavara[1].For the character average fruit weight, the crosses that proved superior were Byadgi Kaddi x G-4 (27.78%), Byadgi Kaddi x Arka Lohit (27.27%) and Byadgi Kaddi x Arka Suphal (25.00%), over better parent and Byadgi Dabbi x G-4 (35.66%), Byadgi Dabbi × Byadgi Kaddi (32.41%) and Byadgi Dabbi x Arka Lohit (26.90%), over standard check showing high and significant magnitudes of heterosis effects. Finding of Suryakumari *et al.*[13] supported the results.For stalk weight all fifteen cross combinations were resulted in significant negative heterosis over better parent while for stalk length the five cross combinations, *viz.*, Byadgi Dabbi × Byadgi Kaddi (18.28%), Byadgi Kaddi × Arka Suphal (11.05%), Byadgi Dabbi × Pant C-1 (6.41%), Byadgi Dabbi × Arka Lohit and Arka Lohit × Pant C-1(0.26%) were resulted in significant positive heterosis over better parent. While all fifteen cross combination revealed Significant negative heterosis over the check.The findings are in accordance with that of Sharma *et al.*[11].Thirteen cross combinations exhibited significant negative heterosis over better parent.for number of fruits per plant. while all fifteen-cross combination revealed significant negative heterosis over the check (Arka Harita). The finding of Khalil and Hatem[6] supported the above results.For fruit yield per plant and per plot the cross Byadgi Dabbi × G-4 (60.48%), showed highest heterosis over better parent while the cross Byadgi Dabbi × Arka Lohit (24.24%), showed maximum heterosis over standard check followed by Byadgi Kaddi × Arka Lohit (2.02 %) and Byadgi Dabbi × G-4 (0.51%). The findings are in accordance with that of Spaldon *et al.*[12].

Table 1: Estimation of per cent heterosis over better parent(BP) and commercial check Arka Harita for important hybrid in chilli

SL.No.	Crossess	Plant Height(cm)		Number of Primary Branches		Stem Girth(cm)		Days to 50% flowering		Days to first fruit harvest		Fruit length(cm)		Fruit Diameter(cm)	
		BP	Check	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check
1	BDXBK	11.17**	0.91	-12.88**	-20.34**	4.18**	4.67**	-12.06**	-7.35**	-8.52**	-4.35**	-16.00**	-4.25**	-26.34**	24.79**
2	BDXAL	-36.74**	-42.58**	-31.41**	-6.00**	-1.23**	-1.26**	-3.71**	1.45**	-0.60	0.81	-25.82**	-32.63**	-7.32**	57.02**
3	BDXAS	-27.06**	-33.80**	-7.73**	-10.49**	-0.99**	-0.96**	-10.20**	-5.40**	-5.67**	-1.37**	-24.97**	-31.85**	-1.95**	66.12**
4	BDXG4	1.80	-7.60**	-9.32**	6.21**	-10.62**	-10.59**	-4.30**	0.82	-4.38**	-0.95	-2.98**	-11.87**	-4.39**	61.98**
5	BDXPC1	29.57**	22.90**	-19.17**	11.99**	-2.88**	-0.22	0.27	5.64**	0.14	4.70**	-32.84**	-39.00**	-16.10**	42.15**
6	BKXAL	-32.76**	-39.97**	-33.91**	-9.42**	-6.88**	-6.44**	2.71**	8.74**	4.51**	5.99**	-23.12**	-12.36**	-24.12**	24.79**
7	BKXAS	-29.51**	-37.06**	-13.25**	-15.85**	6.88**	7.41**	-8.88**	-2.08**	-9.09**	-3.86**	-35.39**	-26.35**	28.89**	43.80**
8	BKXG4	2.35	-8.62**	-27.24**	-14.78**	2.95**	3.48**	-1.50**	8.29**	-4.52**	-1.10**	-23.12**	-12.36**	5.06**	54.55**
9	BKXPC1	14.81**	8.90**	-24.11**	5.14**	-0.48**	2.22**	-17.05**	-8.88**	-0.42	4.34**	-23.45**	-12.74**	32.00**	36.36**
10	ALXAS	-16.12**	-41.93**	-24.22**	3.85**	2.63**	-3.70**	-10.36**	-5.09**	-5.79**	-4.45**	-23.08**	-46.91**	1.01**	66.12**
11	ALXG4	-10.76**	-24.33**	-23.75**	4.50**	-5.00**	-10.89**	-3.43**	2.24**	4.59**	6.08	-27.72**	-35.81**	-1.51**	61.98**
12	ALXPC1	-21.45**	-25.49**	-14.53**	18.42**	-4.33**	-1.70**	-3.72**	1.94**	-7.14**	-5.82**	-33.67**	-49.81**	11.56**	83.47**
13	ASXG4	-17.19**	-29.78**	-10.24**	5.14**	2.20**	-8.15**	-4.84**	2.27**	-9.36**	-6.11**	-24.24**	-32.72**	9.55**	61.16**
14	ASXPC1	-23.50**	-27.44**	-25.19**	3.64**	-13.94**	-11.63**	-5.17**	1.91**	-2.52**	2.13**	-20.79**	-40.06**	28.89**	43.80**
15	G4XPC1	-4.68**	-9.58**	-15.61**	16.92**	-5.05**	-2.44**	-10.43**	-1.61**	-4.93**	-1.52**	-26.52**	-34.75**	9.55**	61.16**
SE		1.12	1.04	0.07	0.05	0.10	0.10	0.43	0.36	0.83	0.74	0.04	0.04	0.05	0.04
CD at 5%		2.24	2.08	0.14	0.10	0.20	0.20	0.86	0.72	1.66	1.48	0.08	0.08	0.100	0.08

*and ** indicates significance of value at 5 and 1% respectively

(Contd.)

(Contd.)

SL.No.	Crossess	Average fruit weight (g)		Stalk length		Stalk weight		Number of fruits per plant		Yield per plant (kg)		Yield per plot (kg)	
		BP	Check	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check
1	BDXBK	17.79**	32.41**	18.28**	-1.12**	-8.57**	45.45**	-12.93**	-52.76**	1.29**	-36.36**	1.61**	-36.36**
2	BDXAL	12.88**	26.90**	0.26	-11.69**	-37.14**	0.00	-9.31**	-3.77**	30.88**	24.24**	30.85**	24.24**
3	BDXAS	10.43**	24.14**	-7.37**	-20.90**	-33.33**	5.91**	-9.25**	-50.76**	-1.13**	-37.88**	-0.81	-37.88**
4	BDXG4	20.65**	35.66**	-13.60**	-18.65**	-49.52**	-19.55**	2.05**	-26.93**	60.06**	0.30	60.48**	0.51
5	BDXPC1	-6.75**	4.83**	6.41**	-16.63**	-62.86**	-40.91**	-22.13**	-57.75**	-28.50**	-55.15**	-28.23**	-55.05**
6	BKXAL	27.27**	15.86**	-18.88**	-28.54**	-12.90**	-18.18**	-19.30**	-14.38**	7.35**	1.82**	7.45**	2.02**
7	BKXAS	25.00**	13.79**	11.05**	-5.17**	-8.00**	4.55**	7.34**	-42.94**	44.05**	-33.94**	43.96**	-33.84**
8	BKXG4	27.78**	16.34**	-12.65**	-17.75**	-12.90**	-18.18**	-21.89**	-44.07**	25.05**	-34.55**	25.00**	-34.34**
9	BKXPC1	22.73**	11.72**	-5.91**	-21.35**	-32.26**	-36.36**	-14.74**	-58.66**	42.12**	-36.36**	4.49**	-53.03**
10	ALXAS	10.50**	-3.24**	-6.38**	-17.53**	-28.00**	-18.18**	-44.73**	-41.35**	-38.87**	-42.12**	-38.83**	-41.92**
11	ALXG4	8.66**	-4.83**	-18.62**	-23.37**	-15.79**	-27.27**	-26.96**	-22.50**	-20.77**	-24.85**	-20.74**	-24.75**
12	ALXPC1	14.17**	0.00	0.26	-11.69**	-26.32**	-36.36**	-35.95**	-32.04**	-27.16**	-30.91**	-27.13**	-30.81**
13	ASXG4	15.45**	-2.07**	-8.59**	-13.93**	-32.00**	-22.73**	-12.05**	-37.02**	18.30**	-37.88**	18.27**	-37.88**
14	ASXPC1	9.21**	-7.38**	-9.47**	-22.70**	-44.00**	-36.36**	-7.92**	-51.05**	1.10**	-53.64**	1.10**	-53.54**
15	G4XPC1	23.08**	-11.72**	-13.60**	-18.65**	-16.67**	-31.82**	-22.70**	-44.65**	-5.78**	-50.61**	-5.77**	-50.51**
SE		0.04	0.04	0.02	0.02	0.01	0.02	0.94	0.82	0.01	0.01	0.02	0.02
CD at 5%		0.08	0.08	0.04	0.04	0.02	0.04	1.88	1.64	0.02	0.02	0.04	0.04

*and ** indicates significance of value at 5 and 1% respectively.

Table 2: Top three parents and cross combinations on the basis of their *per se* performance and heterotic value

Traits	*Per se* performance		Heterosis	
	Parents	Crosses	Better Parent (%)	Standard Check (%)
Plant height (cm)	PC-1 (85.77), B D (82.07), B K (80.73).	B D × PC-1 (111.13), B K × PC-1 (98.47), B D × B K (91.24).	B D × PC-1 (29.57), B K × PC-1 (14.81), B D × B K (11.17).	B D × PC-1 (22.90), B K × PC-1 (8.90), B D × B K (0.91).
Number of primary branches per plant	PC-1 (6.47), A L (6.40), G-4 (5.47).	A L × PC-1 (5.53), G-4 × PC-1 (5.46), B D × PC-1 (5.23).	A S × G-4 (-10.24), B D × G-4 (-9.32), B D × A S (-7.73).	A L × PC-1 (18.42), G-4 × PC-1 (16.92), B D × PC-1 (11.99).
Stem girth (cm)	PC-1 (1.39), B K (1.36), B D (1.35).	B K × A S (1.45), B D × B K (1.41), B K × G-4 (1.40).	B K × A S (6.88), B D × B K (4.18), B K × G-4 (2.95).	B K × A S (7.41), B D × B K (4.67), B K × G-4 (3.48).
Days to 50 per cent flowering (days)	B D (77.13), A L (77.51), A S (78.68).	B K × PC-1 (66.71), B D × B K (67.83), B D × A S (69.26).	B K × PC-1 (-17.05), B D × B K (-12.06), G-4 × PC-1 (-10.43).	B K × A S (-8.88), B D × B K (-7.35), B D × A S (-5.40).
Days to first fruit harvesting (days)	A L (108.89), G-4 (111.21), B D (112.26).	A S × G-4 (100.80), A L × PC-1 (101.12), A L × A S (102.58).	A S × G-4 (-9.36), B K × A S (-9.09), B D × B K (-8.52).	A S × G-4 (-6.11), A L × PC-1 (-5.82), A L × A S (-4.45).
Fruit length (cm)	B K (11.81), B D (9.41), G-4 (9.20).	B D × B K (9.92), B D × G-4 (9.13), B K × A L (9.08).	A S × PC-1 (-20.79), B D × B K (-16.00), B D × G-4 (-2.98).	B K × A L (-12.36), B D × G-4 (-11.87), B D × B K (-4.25).
Fruit diameter (cm)	B D (2.05), A L (1.99), G-4 (1.78).	A L × PC-1 (2.22), B D × A S (2.01), A L × A S (2.01).	B K × PC-1 (32.00), A S × PC-1 (28.89), B K × A S (28.89).	A L × PC-1 (83.47), A L × A S (66.12), B D × A S (66.12).
Average Fruit weight (g)	B D (1.63), B K (1.32), A L (1.27).	B D × G-4 (1.97), B D × B K (1.92), B D × A L (1.84)	B K × G-4 (27.78), B K × A L (27.27), B K × A S (25.00).	B D × G-4 (35.66), B D × B K (32.41), B D × A L (26.90).
Stalk length(cm) and	PC-1 (3.36), B D (3.49), B K (3.72).	B K × A L (3.18), A L × G-4 (3.41), A S × PC-1 (3.44).	B K × A L (-18.88), A L × G-4 (-18.62), B D × G-4 (-13.60).	B K × A L (-28.54), A S × PC-1 (-22.70), B D × A S (-20.90).
Number of fruits per plant	A L (246.26), B D (125.94), A S (123.38).	B D × A L (223.34), B K × A L (198.73), A L × G-4 (179.87).	B K × A S (7.34), B D × G-4 (2.05), A S × PC-1 (-7.92).	A L × G-4 (-22.50), B K × A L (-14.38), B D × A L (-3.77).
Yield per plant (kg)	A L (0.313), B D (0.207), G-4 (0.173).	B D × A L (0.410), B K × A L (0.336), B D × G-4 (0.331).	B D × G-4 (60.06), B K × A S (44.05), B K × PC-1 (42.12).	B D × A L (24.24), B K × A L (1.82), B D × G-4 (0.30).

Where,

BD= Byadgi Dabbi, BK= Byadgi Kaddi, AL= Arka Lohit, AS= Arka Suphal, PC-1= Pant C-1

REFERENCES

1. Ajjappalavara, P S., Variability, genetic diversity and heterosis study in chilli (*Capsicum annuum* L.). *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka India (2003).
2. Dejan, C., Nenad, P., Milka, B. and Zdenka, G., The importance of earliness for creating new *ms* F_1 pepper hybrids. *Genetika* **42(3):** 521-528 (2010).
3. Heiser, C B. and Smith, P G., The cultivated capsicum peppers. *Economic Botany* **7:** 214-227 (1953).
4. Kamble, C., Mulge, R., Madalageri, M B. and Jadeesha, R C., Studies on heterosis in capsicum (*Capsicum annuum* L.) for yield and yield traits. *Karnataka Journal of Agricultural Science* **22(1):** 155-157 (2009).
5. Karthik, M N., Kumar, S. and Shetty, G R., General combining ability and specific combining ability for yield and quality traits in chilli (*capsicum annuum* l.). *Crop Research Hisar* **37(113):** 137-143 (2009).
6. Khalil, M R. and Hatem, M K., Study on combining ability and heterosis of yield and its components in pepper (*Capsicum annum* L.). *Alex Journal of Agricultural research* **59(1):** 61-71 (2014).
7. Krishnamurthy, S L., Rao, M., Reddy, M., Ramesh, S., Hittalmani, S. and Rao, G., Relationship between morphological and amplified fragment length polymorphism (AFLP) marker based genetic distance with heterosis in hot pepper (*Capsicum annuum* L.). *Afr. J. Biotechnol*., **11(74):** 13863-13872 (2012).
8. Reddy, M G., Mohankumar, H D. and Salimath, P M., Heterosis studies in chillies (*Capsicum annuum* L.). *Karnataka Journal of Agricultural Science* **21(4):** 570-571.
9. Salvador, M H., Genetic resources of chilli (*Capsicum* spp.) in Mexico. *Proc.of the 16th Int. pepper Conf. Tampico,* Tamaulipas, Mexico, pp. 10-12 (2008).
10. Shankarnag, B., Madalageri, M B. and Mulge, R.., Manifestation of heterosis for growth, earliness and early green fruit yield in chilli. *Indian Journal of Horticulture* **63(4):** 410-414 (2006).
11. Sharma, K V., Punetha, S. and Sharma, B B., Heterosis studies for earliness, fruit yield and yield attributing traits in bell pepper (*Capsicum annuum L.). Afr. J. Biotechnol.,* **8(29):** 4088-4098 (2013).
12. Spaldon, S., Hussainn, S., Jabeen, N. and Lay, P., Heterosis studies for earliness, fruit yield and yield attributing traits in chilli (*Capsicum annuum* L.). *The Bioscan.*, **10(2):** 813-818 (2015).
13. Suryakumari, S., Srihari, D,, Shankar, C R., Reddy, V. and Sanker, A S., Genetic divergence and combining ability studies for exploitation of heterosis in paprika (*Capsicum annuum* L.). *Int. J. Agric. Sci. Res.*, **4(2):** 59-66(2014).