International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 2996-2999

Received: 03-07-2019
Accepted: 07-08-2019

TS Kale
College of Agriculture, Latur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

VD Padekar
College of Agriculture, Latur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AD Bhusnar
College of Agriculture, Latur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
TS Kale
College of Agriculture, Latur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Heterosis and inbreeding depression in Chilli (*Capsicum annuum* L.)

TS Kale, VD Padekar and AD Bhusnar

Abstract
The present Investigation was carried out to study the extent of heterosis, inbreeding depression through six generation mean analysis (P_1, P_2, F_1, F_2, BC_1 and BC_2 derived) of three crosses for yield and yield contributing character in ridge gourd (*Luffa acutangula* L.). The material was evaluated in a Randomized Block Design with two replications during summer 2018. The magnitude of heterosis revealed that, the cross combinations Pusa Jwala x Hingoli Local and DCC-25 x G-4 showed significant heterosis over better and mid parent. The inbreeding depression were positively and negatively lower significant indicate that the presence of vigour in F_2.

Keywords: Chilli, Heterosis and inbreeding depression

Introduction
Chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop valued for its aroma, taste, flavor and pungency grown in all parts of world. It belongs to the family solanaceae with the chromosome number 2n=24 and centre of origin of hot Chilli is Mexico. Chilli is one of the most valuable spice crop. The crop is grown largely for its fruit all over the India. It is used in India as a principle ingredient of various curries, and chutneys, it is also used for vegetables, spices, condiments, sauces and pickles. The total area under cultivation of Chilli in India is 268 (000 ha) and production is around 3121 (000 MT) according to NHB. (Anonymous, 2017) [1]. Chilli has good nutritional value and medicinal properties particularly the high content of moisture (85.7%), protein (2.9%), fat (0.6%), mineral matter (1.0%), fiber (6.8%), carbohydrates (3.0%), Kcal (29.0g) vitamin C (111.0mg/100g), (0.5mg/100g), Niacin (0.9/100g). mineral phosphorus (80mg/100g), Carotene (175mg/100g), calcium (30g/100g), iron (4.4mg/100g), magnesium (272mg/100g), manganese (1.38mg/100g), zinc (1.78mg/100g). content in green chilli. Pawar *et al.* (2011) [9]. The cholesterol-reducing properties of capsaicin have been studied by biochemists and reported in the scientific literature. Capsicin has been shown to prevent cholesterol associated heart diseases such as arteriosclerosis and it's more advanced for of atherosclerosis. Information on the magnitude of heterosis in different cross combination is a basic requisite for identifying crosses that exhibit high degree of exploitable heterosis hence heterosis breeding one of the ways to improve the production and productivity is to harness the potential. Therefore the present investigation was carried out with an objective of extend the magnitude of heterosis in different crosses and its confirmation through inbreeding depression in F_2 generation and then utilization in future crop improvement programmes.

Material and Method
Plant material
Crosses *viz.*, cross Pusa Jwala x Hingoli Local, DCC-25 x G-4 and BD-I x G-4 were made between six parents by manual emasculation and pollen transfer. F1 plants were selfed to obtain seed for the F_2 generation and backcrossed with their respective parents to generate BC_1 and BC_2 generations. Thus, a total of six generations were obtained.

Field trial
The six generations (P_1, P_2, F_1, F_2, B_1 and B_2) for each population were planted during 2017. Six populations were planted in randomized block design with two replications. All cultural practices and preventive measures were adopted as per recommendation.

Each plot had one row each of three for each set of experiment (P_1, P_2, F_1, F_2, B_1 and B_2). Each row consisted of 20 plants and having spacing 60cm x 45cm respectively. Randomly selected five plants from each treatments and replication for plant height (cm), number of branches per plant, days to first flower, days to 50% flowering, days to first harvest of green Chilli, length of fruits (cm), diameter of fruits (mm), weight of fruits (g), pedicel length (cm), green fruits per plant, green fruit yield per plant (g), green fruit yield per plot (kg), green fruit yield per hectare (q).

Statistical analysis

Analysis of variance for RBD was carried out by panse sukhatme for all metric character under study, for estimation of relative heterosis and heterobeltiosis were computed as per Jinks and Jones (1958) [5] and Mather (1949) [6].

Results and Discussion

Analysis of variance for yield and yield component showed highly significant differences among the genotypes which indicated that the presence of substantial variability in the material under study and possibility of selection for fruit yield traits in ridge gourd. In the present study, the value of heterosis expressed as percentage increase or decrease over better and mid parent. The data for heterosis over better and mid parent are presented in (Table.1). The heterosis in favorable direction is only considered for the characters. For the trait plant height Heterobeltiosis ranged from 4.98 (Pusa Jwala x Hingoli Local) to 21.73 (BD-I x G-4) and mid parent ranged from 8.53 (Pusa Jwala x Hingoli Local) to 13.13 (BD-I x G-4). All the crosses were recorded positively significant heterosis over mid parent and better parent except the cross Pusa Jwala x Hingoli Local was observed positively. Similar result reported by Abrham *et al*., (2017) [2] and Reddy (2017) [13]. for number of branches per plant Heterobeltiosis ranged from 28.00 (BD-I x G-4) to 68.00 (DCC-25 x G-4) and mid parent ranged from 35.78 (Pusa Jwala x Hingoli Local) to 57.50 (DCC-25 x G-4) and the Cross DCC-25 x G-4 (68.00 to 57.00) observed positively significant over mid parent and better parent and the cross Pusa Jwala x Hingoli Local (51.02) was positively significant heterosis over better parent. Similar result reported by Rohini *et al.,* (2016) [15] and Rohini *et al.,* (2017) [16]. For days to first flower heterobeltiosis ranged was from -7.95 (Pusa Jwala x Hingoli Local) to-16.66 (DCC-25 x G-4) and mid parent ranged from -8.98 (Pusa Jwala x Hingoli Local) to -18.03 (DCC-25 x G-4). The three crosses *viz.,* Pusa Jwala x Hingoli Local, DCC-25 x G-4 and BD-I x G-4 were observed negatively significant heterosis over better parent and mid parent respectively Similar result reported by Kumar and Singh (2016) [7]. For days to fifty percent flower the two crosses BD-I x G-4 (-17.14 -17.14) and DCC-25 x G-4 (-12.37, -15.42) showed negatively significant heterosis over better parent and mid parent. While, the cross Pusa Jwala x Hingoli Local was observed negatively heterosis over mid parent. Similar result reported by Rohini *et al.,* (2017) [16] and Rao *et al*., (2017) [14]. Days to first harvest of green chilli Heterobeltiosis ranged was from -4.73 (BD-I x G-4) to -13.49 (DCC-25 x G-4) and mid parent ranged from -6.32 (BD-I x G-4) to -13.14 (DCC-25 x G-4). The three crosses *viz.,* Pusa Jwala x Hingoli Local, DCC-25 x G-4 and BD-I x G-4 shows negatively significant over mid and better parent. The similar result reported by Sharma *et al*., (2013). For length of fruits Heterobeltiosis ranged from 1.25 (Pusa Jwala x Hingoli Local) to 13.72 (DCC-25 x G-4) and mid parent ranged from 6.11 (BD-I x G-4) to 21.35 (Pusa Jwala x Hingoli Local). The cross DCC-25 x G-4 (13.72, 12.50) was observed highly positively significant heterosis over mid and better parent. The cross Pusa Jwala x Hingoli Local (1.25) was observed positively heterosis over better parent and the cross BD-I x G-4 was observed positively (4.25) heterosis over better parent. Similar result reported by Rohini *et al.,* (2017) [16]. For diameter of fruits Heterobeltiosis ranged from 8.71 (DCC-25 x G-4) to 23.57 (Pusa Jwala x Hingoli Local) and mid parent ranged from 2.23 (BD-I x G-4) to23.57 (Pusa Jwala x Hingoli Local). Similar result reported by Sharma *et al.,* (2013). For weight of fruits Heterobeltiosis ranged from 6.45 (DCC-25 x G-4) to 24.14 (BD-I x G-4) and mid parent ranged from 8.19 (DCC-25 x G-4) to 18.03 (BD-I x G-4). The two crosses Pusa Jwala x Hingoli Local (20.00, 11.11) and BD-I x G-4 (24.14, 18.03) observed positively significant heterosis over better parent and mid parent and the cross DCC-25 x G-4 was observed positively heterosis over better parent and mid parent. Similar result reported by Islam *et al.,* (2012) [8]. For pedicel length Heterobeltiosis ranged from -3.70 (Pusa Jwala x Hingoli Local) to -21.40 (BD-I x G-4) and mid parent ranged from -6.30 (Pusa Jwala x Hingoli Local) to -27.58 (DCC-25 x G-4) and the crosses Pusa Jwala x Hingoli Local and BD-I x G-4 was observed positively significant heterosis over mid and better parent. While, the cross DCC-25 x G-4 was negatively observed Similar result reported by Daware *et al.,* (2019) [4] for green fruits per plants Heterobeltiosis ranged from 10.68 (BD-I x G-4) to 31.57 (DCC-25 x G-4) and mid parent ranged from 20.70 (Pusa Jwala x Hingoli Local)to 33.92 (DCC-25 x G-4) the three crosses *viz.,* Pusa Jwala x Hingoli Local DCC-25 x G-4 and BD-I x G-4 observed positively significant over better and mid parent. Similar result reported by Savaliya *et al.,* (2017) [17] for green fruits yield per plant Heterobeltiosis ranged from 47.33 (Pusa Jwala x Hingoli Local) to 98.45 (DCC-25 x G-4) and mid parent ranged from 23.83 (BD-I x G-4) to 139.7 (DCC-25 x G-4). The three crosses *viz.,* Pusa Jwala x Hingoli Local, DCC-25 x G-4 and BD-I x G-4 observed positively significant over better parent and mid parent. Similar result reported by Aisyah *et al.,* (2016) [3] and Reddy (2017) [13] for green fruit yield per plot Heterobeltiosis ranged from 43.05 (Pusa Jwala x Hingoli Local) to 95.58 (DCC-25 x G-4) and mid parent ranged from 39.37 (Pusa Jwala x Hingoli Local) to 89.55 (DCC-25 x G-4). All three crosses were observed positively significant for heterosis over better parent and mid parent for yield per hectare Heterobeltiosis ranged from 36.88 (Pusa Jwala x Hingoli Local) to 95.66 (DCC-25 x G-4) and mid parent ranged from 36.38 (Pusa Jwala x Hingoli Local) to 119.17 (DCC-25 x G-4). The two crosses Pusa Jwala x Hingoli Local and DCC-25 x G-4 observed positively significant over better parent and mid parent. While, the cross BD-I x G-4 was observed positively significant heterosis over better parent and positively observed mid parent.

Inbreeding Depression

Estimate of inbreeding depression for all character presented in (Table.1) Highest inbreeding depression were observed in the crosses Pusa Jwala x Hingoli Local for number of branches per plant (43.24), green fruits per plant (28.49). DCC-25 x G-4 days to 50% flowering (-21.76) days to first harvest green chilli (-14.67) green fruit yield per plant (47.39) green fruit yield per plot (42.09) green fruit yield per ha (44.42), BD-I x G-4 for plant height (14.88) days to first flower (-15.58) length of fruits (10.78) diameter of fruits (17.47) weight of fruits (19.44) pedicel length (-31.04). Similar results were obtained with agreement of Prajapati and

Agalodia (2011) [10] and Spaldon *et al.*, (2015) [18], Reddy (2017) [13] and Sahu (2009) [20], Rao *et al.*, (2017) [14], Payakhapaab *et al.*, (2012) [11], Negi *et al.*, (2012) [19]

Table 1: Heterosis, inbreeding depression and component of heterosis for 13 characters of 3 crosses in Chilli

Crosses	Percent heterosis over		Inbreeding	Component of heterosis			
	MP %	BP %	Depression %	(h)	(-i)	(-d)	½ j
Plant height (cm)							
Pusa Jwala x Hingoli Local	8.53**	4.98	11.27**	22.62	16.00	1.50	-0.56
DCC-25 X G-4	10.27**	5.92*	9.93**	27.50	20.00	1.00	-1
BD-I X G-4	13.13**	21.73**	14.88**	24.75	15.00	1.50	3.37
Number of branches per plant							
Pusa Jwala x Hingoli Local	35.78*	51.02*	43.24**	3.65	1.70	-0.55	2.00
DCC-25 X G-4	57.50**	68.00*	39.71	6.60	4.30	-0.25	0.25
BD-I X G-4	43.01**	28.00*	39.06**	6.22	4.30	-0.35	-0.43
Days to 1st flower							
Pusa Jwala x Hingoli Local	-8.98**	-7.95*	-6.17**	-11.50	-7.50	-0.75	-0.12
DCC-25 X G-4	-18.03**	-16.66**	-13.33**	-20.75	-12.50	-1.25	-0.25
BD-I X G-4	-14.44**	-13.48**	-15.58**	-24.40	-17.90	-1.45	-0.47
Days to 50% flowering							
Pusa Jwala x Hingoli Local	-8.44	-9.50**	-11.60**	-16.17	-12.00	-1.50	-1.03
DCC-25 X G-4	-15.42**	-12.37**	-21.76**	-29.25	-21.50	0.75	1.25
BD-I X G-4	-17.14**	-17.14*	-16.09**	-30.50	-21.50	0.25	0.12
Days to first harvest of green chilli							
Pusa Jwala x Hingoli Local	-7.59**	-6.14*	-8.22**	-15.90	-11.00	-1.00	0.00
DCC-25 X G-4	-13.14**	-13.49**	-14.67**	-24.25	-16.00	0.25	-0.12
BD-I X G-4	-6.32**	-4.73*	-8.54**	-21.55	-17.60	0.80	0.92

Continue….

Crosses	Percent heterosis over		Inbreeding	Component of heterosis			
	MP %	BP %	Depression %	(h)	(-i)	(-d)	½ j
Length of fruits (cm)							
Pusa Jwala x Hingoli Local	21.35*	1.25	5.92**	-0.57	-2.00	0.04	-0.64
DCC-25 X G-4	12.50**	13.72**	7.17**	-0.75	-1.68	-0.20	-0.06
BD-I X G-4	6.11*	4.26	10.78**	1.90	1.44	-0.12	-0.12
Diameter of fruits (mm)							
Pusa Jwala x Hingoli Local	23.57**	23.57**	8.24**	-0.45	-2.30	0.65	0.32
DCC-25 X G-4	12.76**	8.71*	13.20**	1.30	0.10	0.45	0.05
BD-I X G-4	2.23	-11.20	17.47**	1.42	1.20	0.50	-0.5
Weight of fruits (g)							
Pusa Jwala x Hingoli Local	11.11*	20.00*	10.00**	1.75	-0.40	-0.25	-0.20
DCC-25 X G-4	8.19	6.45	12.12**	0.32	0.20	0.20	0.08
BD-I X G-4	18.03*	24.14**	19.44**	0.57	0.30	-0.35	-0.13
Pedicel length (cm)							
Pusa Jwala x Hingoli Local	-6.30	-3.70	-15.38**	-3.41	-3.24	-0.32	-0.12
DCC-25 X G-4	-27.58**	-18.90**	-27.97**	-2.90	-2..17	-0.02	0.13
BD-I X G-4	-20.12	-21.40	-31.04	-2.72	-2.23	-0.04	-0.04
Green fruits per plant							
Pusa Jwala x Hingoli Local	20.70**	17.70*	28.49**	185.50	153.00	7.50	1.75
DCC-25 X G-4	33.92**	31.57**	24.00**	126.50	1.00	3.50	0.5
BD-I X G-4	23.75**	10.68**	27.56**	151.75	110.00	13.00	-3.87

Continue….

Crosses	Percent heterosis over		Inbreeding	Component of heterosis			
	MP %	BP %	Depression %	(h)	(-i)	(-d)	½ j
Green fruit yield per plant (g)							
Pusa Jwala x Hingoli Local	46.68**	47.33**	34.73**	183.75	104.50	1.25	1
DCC-25 X G-4	139.73**	98.45**	47.390	473.50	263.50	4.75	-13.25
BD-I X G-4	23.83**	48.54**	17.98**	132.37	96.00	3.00	-12.31
Green fruit yield per plot (kg)							
Pusa Jwala x Hingoli Local	39.37**	43.05**	35.92**	5.95	4.50	0.55	0.32
DCC-25 X G-4	89.55**	95.58**	42.09**	8.34	5.00	0.50	0.30
BD-I X G-4	58.70**	51.08**	38.13**	9.88	7.70	0.05	-0.06
Green fruit yield per ha (q)							
Pusa Jwala x Hingoli Local	36.38**	36.88*	23.70**	69.15	44.50	2.75	1.5
DCC-25 X G-4	119.17**	95.66**	44.42**	154.4	82.00	-6.00	-6.65
BD-I X G-4	72.01	62.08**	35.16**	86.90	37.50	-1.75	-2.97

Conclusion

The cross, DCC-25 x G-4 exhibited high heterosis over better parent and mid parent and inbreeding depression for most of the characters. There is a need for evaluation of crosses for simultaneous breeding. Hence the crop had immense potential for heterosis breeding for further improvement of its different traits.

References

1. Anonymous. National Horticulture Board, Advance estimate of year, Government of India, 2017.
2. Abrham S, Mandefro N, Sentayehu A. Heterosisand Heterobeltiosis Study of Hot Pepper (*Capsicum annuum* L.) Genotypes in Southern Ethiopia Int. J of Plant. Breed. And Genet. 2017; 11(2):63-70.
3. Aisyah SI, Wahyuni MS, Witono JR. The estimation of combining ability and heterosis effect for yield and yield components in tomato (*Solanum lycopersicum* Mill.). At Lowland. J of Crop. Breed. And Genet. 2016; 2(1):23-29.
4. Daware SB, Jagtap VS, Kalam SR. Studies on heterosis for yield and yield contributing characters in chilli (*Capsicum annuum* L.). Bull. Env. Pharm. and Life Sci. 2019; 8(4):52-56.
5. Jinks JL, Jones RM. ARC Unit of Biometrical Genetics, University of Birmingham, 1958.
6. Mather K. Biometrical Genetics. Methuen and Co. Ltd. London, 1949.
7. Kumar C, Singh SP. Heterosis and inbreeding depression to identify superior F1 hybrids in tomato (*Solanum lycopersicum* L.) for the yield and its contributing traits. J. of App. and Nat. Sci. 2016; 8(1):290-296.
8. Islam MR, Ahmad S, Rahman MM. Heterosis and qualitative attributes in winter tomato (*Solanum lycopersicum* L.). hybrids Bang. J Agri. Res. 2012; 37(1):39-48.
9. Pawar SS, Bharude NV, Sonone SS, Deshmukh RS, Raut AK, Umarkar AK. Chillies as food, spice and medicine: A perspective Int. J. of pharm. and bio. Sci. 2011; 1(3):311-318.
10. Prajapati DB, Agalodia AV. Heterosis and inbreeding depression in Chilli (*Capsicum annuum* L.). J. of Spic. and Arom. Crops. 2011; 20(2):72-76.
11. Payakhapaab S, Boonyakiat D, Nikornpun M. Evaluation of heterosis and combining ability of yield components in chillies (*Capsicum annuum* L.). J of Agri. Sci. 2012; 4(11):154-161.
12. Panse VG, Sukhatme PV. In statistical methods for Agricultural Workers. Fourth enlarged edition revised by Sukhatme, P. V., and Amble, V. N. Published by sat Prakash, Under-secretary for ICAR, New Delhi, 1985.
13. Reddy GE. Genetics of yield and quality traits in tomato (*Solanum lycopersicum* L.). Ph.D. Thesis, Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, BHU, Varanasi, 2017.
14. Rao PG, Reddy KM, Naresh P, Chalapathi V. Heterosis in bell pepper (*Capsicum annuum* L.) for yield and yield attributing traits Bangladesh J. Bot. 2017; 46(2):745-750.
15. Rohini N, Lakshmanan V. Heterobeltiosis and inbreeding depression for fruit yield and its components in hot pepper (*Capsicum annuum* var. annuum). Asia. J of Hort. 2016; 11(1):86-92.
16. Rohini N, Lakshmanan V, Saraladevi D, Jhon A, Joe A. Heterobeltiosis and genetic Assortive mating for yield and its component characters in hot pepper (*Capsicum annuum* var. annuum). Int. J of Plant. & Soil. Sci. 2017; 14(5):1-12.
17. Savaliya PG, Patel NB, Mungala RA, Movaliya HM. Estimation of gene action, heterosis, genetic advance and other components in brinjal (*Solanum melongena* L.). Int. J. of Chem. Studies. 2017; 5(5):1858-8528.
18. Spaldon S, Hussain S, Jabeen N, Lay P. studies for earliness, fruit yield and yield attributing traits in chilli (*Capsicum annum* L.) The Bios. 2015; 10(2):813-818.
19. Negi PK, Sharma RR, Kumar R. Heterosis and inbreeding depression in tomato under low temperature regime (*Capsicum annuum* L.). Ind. J Hort. 2012; 69(3):443-445.
20. Sahu M. Genetic analysis for fruit yield and bacterial wilt in tomato (*Lycopersicon esculentum* L.). Ph.D. thesis Indira Gandhi Krishi Vishwavidyalaya, Raipur, 2009.