Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 1847-1852
Received: 01-09-2019
Accepted: 03-10-2019

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Heterosis for yield attributing traits in spine gourd (*Momordica dioica* Roxb)

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Abstract

Heterosis for quantitative characters in spine gourd genotypes (10 parents and 21 F_1) was investigated during June to September 2017-18. Analysis of variance revealed highly significant differences among the parents and hybrids for 10 characters studied. Considerable coefficient of variation were observed for Days to first flowering, Days of first flowering node, number of stem per plant, fruit shape, ovary length, ovary diameter, fruit length, single fruit weight, number of fruit per plant, and fruit yield per plant indicating the scope of selection for those characters. The characters like ovary length, ovary diameter, fruit length, single fruit weight, number of fruit per plant, fruit yield per plant contributed the maximum variability towards divergence among spine gourd genotypes. Heterosis study depicted that the crosses. Cross NDM-5 x AJSG-2 showed desirable heterotic cross over mid parent and NDM-5 x AJSG-2 for better parent for single fruit weight. Cross RMDSG-4 X IK-1 showed desirable better parent heterotic cross over mid parent and NDM-2 x CK-2 for better parent and RMDSG-4 X IK-1 for commercial check for number of fruit per plant. Cross RMDSG-4 X AJSG-2 showed desirable heterotic cross over mid parent and crosses NDM-5 x AJSG-2 for better parent and RMDSG-4 X AJSG-2 for commercial check for fruit yield. Therefore the above tested cross combinations could be utilized for isolating superior segregates for these traits or could be exploited in isolating pure line varieties based on performance in spine gourd.

Keywords: Better parent, mid parent, commercial check, heterosis, *Momordica dioica*

Introduction

Spine gourd (*Momordica dioica* Roxb.) is a cucurbitaceous crop, belongs to the family cucurbitaceae with chromosome number 2n=28, under the genus Momordica (Raj *et al*., 1993) [4] and is known by various names like Kakrol, Kartoli, Kankad, Teasel gourd or Bhat kerala. Per 100 g edible fruit was found to contain 84.1% moisture, 7.7 g carbohydrate, 3.1 g protein, 3.1 g fat, 3.0 g fiber and 1.1 g minerals. It also contained small quantities of essential vitamins like ascorbic acid, carotene, thiamin, riboflavin and niacin (Kushwaha *et al.,* 2005) [3]. This popular vegetable has high demand in market because of good nutritional, medicinal value, high keeping quality ability to withstand long distance transportation, high market price and good export potential (Rasul, 2003) [6]. Spine gourd is a native of tropical regions in Asia, Polynesia besides tropical Africa and South America. As many of the species of this genus have been found to grow wide in India, Bangladesh, Sri Lanka, Myanmar and Malay etc. (Hooker, 1879) [2] indicated that this region might be the origin of spine gourd. Kartoli mainly grown in Orissa, Bihar and West Bengal as a crop and kitchen garden plant but occurs as wild in Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Kerala and Maharashtra. It is used as a vegetable in all regions of India and some parts in South Asia. Kakrol has a number of problems including low yield. Fruits become inedible at maturity owing to the presence of large number of hard seeds. Low rate of tuber production 10-20 tuberous pieces per year germination of seeds is very low or impossible due to hard seed coat (Rashid 1976) [5], non-availability of improved varieties, difficulties in propagation by seed due to dormancy, dormancy of tubers and unpredictable sex ratio in seedling progeny (Ali *et al*., 1991) [1]. Therefore, the precise knowledge of combining ability and gene action responsible for yield and yield components is a pre-requisite for launching a successful crop improvement programme. Hybrids will be very easy to commercialize in spine gourd due to its high seed content and easy seed extraction technique. Accordingly, the present investigation is oriented to gain further knowledge on the genetic aspect of yield and its component in spine gourd for commercial exploitation of heterosis.

Materials and Methods

A total of 31 genotypes of spine gourd namely AJSG-1, RMDSG-3, RMDSG-4, AMBIKA13-5, AMBIKA13-6, NDM-2, NDM-5, IK-1, CK-2, AJSG-2 and 21 F_1s namely AJSG-1 x IK-1, AJSG-1 x CK-2 AJSG-1 x AJSG-2 RMDSG-3 x IK-1 RMDSG-3 x CK-2 RMDSG-3 x AJSG-2 RMDSG-4 x IK-1 RMDSG-4 x CK-2 RMDSG-4 x AJSG-2 AMBIKA13-5 x IK-1 AMBIKA13-5 x CK-2 AMBIKA13-5 x AJSG-2 AMBIKA13-6 x IK-1 AMBIKA13-6 x CK-2 AMBIKA13-6 x AJSG-2 NDM-2 x IK-1 NDM-2 x CK-2 NDM-2 x AJSG-2 NDM-5 x IK-1 NDM-5 x CK-2 NDM-5 x AJSG-2 were used in this experiment. No specific crossing pattern was used in this experiment. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications at the experimental field, Department of Genetics and plant Breeding, RMD CARS Ambikapur during the *kharif* season June to September 2017 on an upland soil. Seeds of spine gourd were sown in 2 x 2 cm soil. The unit plot size was 2 m x 2 m^2 accommodating 1 plants in each plot. The pits were dug prior to two weeks of planting in a dimension of 0.5 m x 0.5 m x 0.5 m at spacing of 1.5 m pit to pit. The treatments were randomly assigned to different plots of each block separately. The healthy seedling of 20 days old was transplanted in the pit of the experimental field. All the recommended agronomic practices were adopted to raise a good crop. Data on 10 quantitative characters: viz. Days to first flowering, Days to first flowering node, number of stem per plant, fruit shape, ovary length, ovary diameter, fruit length, single fruit weight, number of fruit per plant, and fruit yield were recorded. The collected data were statistically analyzed. Analysis of variance for each of the character was performed. For estimating the heterosis in each character the mean values of F_1s have been compared with better parent (BP) for Heterobeltiosis, with mid parent (MP) for heterosis over mid parent value and with commercial check (CC) for heterosis over the commercial check value. Percent heterosis was calculated as follows.

Results and Discussion

The mean sum of square due to parent differed significantly, indicating great deal of diversity among them. The heterotic responses of F_1 hybrids over mid parent (MP) better parent (BP) and commercial check (CC) for 31 characters are presented in Table 1. Both positive and negative heterosis was observed for quantitative characters in F_1 hybrids of cucumber. It was noticed that the heterotic performance of the hybrids over their mid parental values were mostly positive. Character wise heterotic performances of the crosses are discussed below:

(1) Days to first flowering

Highest significant positive heterosis (MP) observed by the cross AMBIKA13-5 X IK-1(25.23%) followed by AMBIKA13-5 X CK-2(23.27%). Highest significant positive heterosis (BP) observed by the cross AMBIKA13-5 X IK-1(26.44%) followed by AMBIKA13-5 X CK-2 (23.78%). None of the cross showed significant negative over better parent or mid parent for this trait, Highest significant positive commercial check (CC) observed by the cross AMBIKA13-5 X IK-1 (15.30%) followed by AMBIKA13-5 X CK-2 (12.87%) while none of the hybrids showed significant negative heterosis, significant positive heterosis suggesting the possibility of exploiting heterosis for early days to first flowering in spine gourd.

(2) Number of first flowering node

Highest significant positive heterosis (MP) observed by the cross AJSG-1 X IK-1(49.76%). followed by NDM-2 X IK-1(28.97%), while eleven hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross AJSG-1 X IK-1 (59.60%) followed by AMBIKA13-6 X IK-1 (54.55%), while seven hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross AJSG-1 X IK-1 (59.60%) followed by AMBIKA13-6 X IK-1 (54.55%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for early number of first flowering node in spine gourd.

(3) Number of stem per plant

Highest significant positive heterosis (MP) observed by the cross RMDSG-4 x CK-2 (108.91) followed by RMDSG-3 X CK-2 (88.57%), while none of the hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross RMDSG-4 x CK-2 (92.54) followed by RMDSG-3 X CK-2 (75.00%), while none of the hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross RMDSG-4 x CK-2 (101.56%) followed by AMBIKA13-6 x CK-2 (92.19%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum number of stem per plant in spine gourd.

(4) Fruit length (cm.)

Highest significant positive heterosis (MP) observed by the cross AJSG-1 x CK-2 (53.30) followed by AMBIKA13-5 X AJSG-2 (23.16%). while eight hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross AJSG-1 x CK-2 (53.30) followed by AJSG-1 x IK-1 (49.73%), while four hybrids showed significant negative heterosis. The positive commercial check (CC) observed by the cross while all of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum fruit length in spine gourd.

(5) Ovary length (cm.)

Highest significant positive heterosis (MP) observed by the cross NDM-2 x IK-1 (49.03) followed by NDM-2 X AJSG-2(36.31%) while 15 hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross NDM-2 x IK-1 (35.88) followed by NDM-2 X AJSG-2(29.79%) while 17 hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross AMBIKA13-6 x AJSG-2 (78.57%) followed by NDM-2 x CK-2 (74.29%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum ovary length in spine gourd.

(6) Ovary diameter (cm.)

Highest significant positive heterosis (MP) observed by the cross RMDSG-4 x AJSG-2 (35.54) followed by NDM-5 X CK-2(18.75%), RMDSG-3 X AJSG-2 (15.20%) and RMDSG-4 X CK-2(12.70%) while six hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross RMDSG-4 x

AJSG-2 (32.26) followed by RMDSG-3 X AJSG-2 (14.29%), while eight hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross RMDSG-4 x AJSG-2 (30.16%) followed by NDM-2 x CK-2 (20.63%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum ovary diameter in spine gourd.

(7) Fruit diameter (cm.)

Highest significant positive heterosis (MP) observed by the cross NDM-5 x AJSG-2 (34.40) followed by AJSG-1 X AJSG-2 (27.72%), while six hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross NDM-5 x AJSG-2 (31.53) followed by AJSG-1 X AJSG-2 (25.00%), while 11 hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross NDM-5 x AJSG-2 (13.48%) followed by AMBIKA13-6 x CK-2 (9.07%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum fruit diameter in spine gourd.

(8) Single fruit weight (g.)

Highest significant positive heterosis (MP) observed by the cross NDM-5 x AJSG-2 (20.92) followed by AMBIKA 13-5 x CK-2 (20.78%), while seven hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross NDM-5 x AJSG-2 (20.52) followed by AMBIKA 13-5 x CK-2 (14.81%), while nine hybrids showed significant negative heterosis. The positive commercial check (CC) observed by the cross while all of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum single fruit weight in spine gourd.

(9) Number of fruit per plant

Highest significant positive heterosis (MP) observed by the cross RMDSG-4 X IK-1(50.00%). followed by NDM-2 X AJSG-2 (47.57%), while none of the hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross NDM-2 x CK-2 (45.54) followed by NDM-2 X AJSG-2 (44.76%), while none of the hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross RMDSG-4 x IK-1 and AMBIKA13-6 x IK-1 (43.24%) followed by AMBIKA13-6 x CK-2 (40.54%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for maximum number of fruit per plant in spine gourd.

(10) Fruit yield (q/ha.)

Highest significant positive heterosis (MP) observed by the cross RMDSG-4 X AJSG-2 (66.80%) followed by NDM-5 X AJSG-2(66.43%), while none of the hybrids showed significant negative heterosis. Highest significant positive heterobeltiosis (BP) observed by the cross NDM-5 x AJSG-2 (65.38) followed by NDM-2 X AJSG-2 (63.09%), while none of the hybrids showed significant negative heterosis. Highest significant positive commercial check (CC) observed by the cross RMDSG-4 x AJSG-2 (30.81%) followed by AMBIKA13-5 x CK-2 (27.99%) while none of the hybrids showed significant negative heterosis, Significant positive heterosis suggesting the possibility of exploiting heterosis for high fruit yield in spine gourd.

Conclusion

Considerable variability for most of the quantitative traits of spine gourd observed among the studied genotypes. In present study cross AJSG-1 x IK-1showed desirable heterotic cross over mid parent NDM-2 x IK-1 for better parent and AMBIKA13-5 x IK-1 for commercial check for days to first flowering (Table 2). Cross AJSG-1 X IK-1 registered as desirable heterotic cross over mid parent and AJSG-1 X IK-1 for better parent and AJSG-1 X IK-1for commercial check for number of first flowering node. Cross RMDSG-4 x CK-2 showed desirable heterotic cross over mid parent and RMDSG-4 x CK-2 for better parent and RMDSG-4 x CK-2 for commercial check for number of stem per plant. Cross AJSG-1 x CK-2 showed desirable heterotic cross over mid parent and AJSG-1 x CK-2 for better parent for Fruit length. Cross NDM-2 x IK-1 showed desirable heterotic cross over mid parent and NDM-2 x IK-1 and NDM-2 X AJSG-2 for better parent and AMBIKA13-6 X AJSG-2 for commercial check for Ovary length. Cross RMDSG-4 x AJSG-2 showed desirable heterotic cross over mid parent and RMDSG-4 x AJSG-2 for better parent and RMDSG-4 X AJSG-2 for commercial check for ovary diameter. Cross NDM-5 x AJSG-2 showed desirable heterotic cross over mid parent and NDM-5 x AJSG-2 for better parent and NDM-5 X AJSG-2 for commercial check for fruit diameter. Cross NDM-5 x AJSG-2 showed desirable heterotic cross over mid parent and NDM-5 x AJSG-2 for better parent for single fruit weight. Cross RMDSG-4 X IK-1 showed desirable better parent heterotic cross over mid parent and NDM-2 x CK-2 for better parent and RMDSG-4 X IK-1 and AMBIKA13-6 x IK-1 for commercial check for number of fruit per plant. Cross RMDSG-4 X AJSG-2 showed desirable heterotic cross over mid parent and crosses NDM-5 x AJSG-2 for better parent and RMDSG-4 X AJSG-2 for commercial check for fruit yield.

Acknowledgment

Authors are thankful to authorities of the I.G.K.V. Raipur and ICAR- AICRN on potential crops for providing necessary faculties and support for conducting research work.

Table 1: Estimation of heterosis (%) over mid parent, better parent and commercial check for yield and its attributes in spine gourd

Hybrids	Days to first flowering			Number of first flowering node			Number of stem per plant			Fruit length (cm.)			Ovary length (cm.)		
	MP	BP	CC	MP	BP	CC	MP	BP	CC	MP	BP	CC	MP	BP	CC
AJSG-1 X IK-1	7.55**	7.61**	5.98**	49.76**	59.60**	59.60**	39.85**	34.78**	45.31**	19.26**	49.73**	-0.91	-5.84**	-13.69**	3.57
AJSG-1 X CK-2	8.90**	9.17**	1.32	-0.37	19.64**	35.35**	39.44**	26.81**	36.72**	53.30**	53.30**	1.45	-6.48**	-11.23**	18.57**
AJSG-1 X AJSG-2	11.29**	11.46**	6.38**	-2.42	8.04**	22.22**	26.81**	26.81**	36.72**	3.76	9.89**	-27.27**	-10.11**	-14.89**	14.29**
RMDSG-3 X IK-1	9.41**	9.72**	2.94	15.35**	40.40**	40.40**	35.38**	33.33**	37.50**	-0.60	9.91**	-9.27	-19.15**	-35.59**	8.57**
RMDSG-3 X CK-2	15.42**	15.50**	7.19**	-23.08**	-19.01**	16.16**	88.57**	75.00**	80.47**	17.85**	32.42**	-12.36**	-6.86**	-16.53**	40.71**
RMDSG-3 X AJSG-2	10.71**	10.80**	3.95	0.72	2.94	41.41**	6.67**	4.35**	12.50**	-14.98**	-10.07**	-33.45**	-12.26**	-21.19**	32.86**
RMDSG-4 X IK-1	8.68**	8.86**	4.56**	8.06**	35.35**	35.35**	57.25**	53.73**	60.94**	-16.07**	-12.60**	-19.27**	-33.66**	-49.63**	-2.86
RMDSG-4 X CK-2	9.66**	9.83**	1.93	-13.07	-10.74**	34.34**	108.91**	92.54**	101.56**	5.05	25.82**	-16.73**	-27.35**	-38.52**	18.57**
RMDSG-4 X AJSG-2	16.30**	16.35**	11.04**	-7.37**	-2.94	33.33**	54.41**	52.17**	64.06**	-16.28**	-5.90**	-30.36**	-23.58**	-35.19**	25.00**
AMBIKA13-5 X IK-1	25.23**	26.44**	15.30**	-6.77**	18.18**	18.18**	39.04**	23.78**	58.59**	17.03**	46.45**	-2.55	-18.93**	-35.32**	8.57**
AMBIKA13-5 X CK-2	23.57**	23.78**	12.87**	-35.28**	-34.21**	1.01	67.51**	41.46**	81.25**	-2.74	-2.47	-35.45**	-18.01**	-26.38**	23.57**
AMBIKA13-5 X AJSG-2	11.29**	11.56**	1.72	-6.25**	-0.74	36.36**	45.70**	34.15**	71.88**	23.16**	30.05**	-13.45**	-16.78**	-25.11**	25.71**
AMBIKA13-6 X IK-1	13.19**	13.64**	6.38**	22.89**	54.55**	54.55**	28.16**	9.39**	54.69**	-4.93	15.63**	-19.27**	-1.12	-18.52**	25.71**
AMBIKA13-6 X CK-2	13.91**	13.97**	5.78**	-34.20**	-32.67**	2.02	67.35**	35.91**	92.19**	6.42**	9.34**	-27.64**	-17.12**	-22.69**	19.29**
AMBIKA13-6 X AJSG-2	9.65**	9.74**	2.74	-15.38**	-11.03**	22.22**	45.45**	28.18**	81.25**	5.44	8.59**	-24.18**	23.76**	15.74**	78.57**
NDM-2 X IK-1	7.28**	7.48**	1.93	28.97**	39.39**	39.39**	34.90**	18.24**	57.03**	-12.80**	-1.15	-22.00**	49.03**	35.88**	65.00**
NDM-2 X CK-2	10.15**	10.26**	2.33	0.74	19.13**	38.38**	32.16**	10.00**	46.09**	4.26	14.29**	-24.36**	4.20	-0.53	32.86**
NDM-2 X AJSG-2	8.52**	8.55**	2.94	-4.38	4.35	21.21**	49.35**	35.29**	79.69**	-12.49**	-9.58**	-33.09**	36.31**	29.79**	74.29**
NDM-5 X IK-1	11.41**	11.80**	4.66**	-23.32**	-2.02	-2.02	32.17**	19.62**	47.66**	-6.19**	0.21	-11.82**	4.90	-12.08**	30.00**
NDM-5 X CK-2	15.00**	15.07**	6.79**	-19.61**	-18.83**	26.26**	67.53**	43.67**	77.34**	-6.37**	9.07**	-27.82**	-21.83**	-25.60**	10.00**
NDM-5 X AJSG-2	8.79**	8.87**	1.93	-16.55**	-11.03**	22.22**	36.49**	27.85**	57.81**	-8.42**	0.25	-25.82**	-20.00**	-23.67**	12.86**

Hybrids	Ovary diameter (cm.)			Fruit diameter (cm.)			Single fruit weight (g.)			Number of fruit per plant			Fruit yield (q/ha.)		
	MP	BP	CC	MP	BP	CC	MP	BP	CC	MP	BP	CC	MP	BP	CC
AJSG-1 X IK-1	-19.38**	-21.21**	-17.46**	9.80**	0.25	0.25	-9.71**	-15.38**	-15.38**	40.57**	34.23**	34.23**	26.54**	13.63**	13.63**
AJSG-1 X CK-2	-12.78**	-13.43**	-7.94	3.81	-9.31**	0.25	9.00**	1.17	-11.54**	41.58**	41.58**	28.83**	54.29**	43.20**	13.98**
AJSG-1 X AJSG-2	-7.81**	-10.61**	-6.35	27.72**	25.00**	7.84**	-2.17	-7.33**	-18.97**	34.95**	32.38**	25.23**	32.14**	27.48**	1.47
RMDSG-3 X IK-1	-7.94**	-7.94**	-7.94	-7.29**	-8.09**	-8.09**	-22.12**	-24.62**	-24.62**	42.45**	36.04**	36.04**	10.92**	2.70	2.70
RMDSG-3 X CK-2	4.62	1.49	7.94**	-5.63**	-10.86**	-1.47	10.20**	-0.82	-7.18	37.62**	37.62**	25.23**	51.65**	36.49**	16.26**
RMDSG-3 X AJSG-2	15.20**	14.29**	14.29**	7.84**	1.25	-0.49	2.39	-6.03**	-12.05**	44.66**	41.90**	34.23**	48.38**	38.63**	18.08**
RMDSG-4 X IK-1	9.84**	6.35**	6.35	7.55**	1.23	1.23	-9.26**	-13.33**	-13.33**	50.00**	43.24**	43.24**	35.82**	24.19**	24.19**
RMDSG-4 X CK-2	12.70**	5.97**	12.70**	1.36	-8.87**	0.74	14.37**	4.23	-5.13	42.57**	42.57**	29.73**	63.04**	48.56**	23.11**
RMDSG-4 X AJSG-2	35.54**	32.26**	30.16**	12.92**	11.67**	-1.47	17.58**	9.30**	-0.51	41.75**	39.05**	31.53**	66.80**	57.86**	30.81**
AMBIKA13-5 X IK-1	2.36	1.56	3.17	-1.10	-1.22	-0.98	-11.76**	-19.23**	-19.23**	28.76**	22.95**	35.14**	14.28**	9.31**	9.31**
AMBIKA13-5 X CK-2	9.92**	7.46**	14.29**	-5.58**	-9.98**	-0.49	20.78**	14.81**	-4.62	33.63**	22.13**	34.23**	60.52**	40.16**	27.99**
AMBIKA13-5 X AJSG-2	3.17	1.56	3.17	0.13	-6.85**	-6.62	4.93	1.85	-15.38**	24.23**	15.57**	27.03**	30.05**	17.71**	7.49**

AMBIKA13-6 X IK-1	-5.97**	-11.27**	0.00	-16.13**	-18.18**	-13.97**	-10.56**	-17.44**	-17.44**	37.66**	32.50**	43.24**	23.58**	18.30**	18.30**
AMBIKA13-6 X CK-2	-14.49**	-16.90**	-6.35	1.14	-1.33	9.07**	8.04**	1.82	-13.85**	41.18**	30.00**	40.54**	51.57**	32.26**	20.96**
AMBIKA13-6 X AJSG-2	-2.26	-8.45**	3.17	-7.55**	-15.85**	-11.52**	13.39**	9.09**	-7.69	35.11**	26.67**	36.94**	52.62**	38.04**	26.25**
NDM-2 X IK-1	8.87**	7.14**	7.14**	12.45**	-1.47	-1.47	-9.42**	-17.44**	-17.44**	38.68**	32.43**	32.43**	25.04**	9.36**	9.36**
NDM-2 X CK-2	18.75**	13.43**	20.63**	3.96	-12.64**	-3.43	13.54**	8.41**	-10.77**	45.54**	45.54**	32.43**	65.21**	57.75**	18.18**
NDM-2 X AJSG-2	-4.07	-4.84	-6.35	19.27**	11.65**	-3.68	11.18**	8.41**	-10.77**	47.57**	44.76**	36.94**	64.11**	63.09**	22.18**
NDM-5 X IK-1	6.06**	1.45	11.11**	-6.31**	-14.46**	-14.46**	-10.47**	-20.00**	-20.00**	42.06**	36.94**	36.94**	26.60**	9.54**	9.54**
NDM-5 X CK-2	-5.15	-6.52**	2.38	2.54	-10.42**	-0.98	12.85**	10.10**	-13.33**	38.24**	36.89**	27.03**	55.96**	50.73**	10.11**
NDM-5 X AJSG-2	6.87**	1.45	11.11**	34.40**	31.53**	13.48**	20.92**	20.52**	-5.13	37.69**	36.38**	29.01**	66.43**	65.38**	22.36**

*, ** differ significantly at 5 and 1 percent level of probability, respectively.

Table 2: Top heterosis crosses over mid parent, better parent and commercial check for different traits in spin gourd.

S. N.	Characters	Mid Parent	Better Parent	Commercial Check
1	Days to first flowering	AJSG-1 x IK-1	NDM-2 x IK-1	AMBIKA13-5 x IK-1
2	Number of first flowering node	AJSG-1 X IK-1	AJSG-1 X IK-1, AMBIKA13-6 X IK-1	AJSG-1 X IK-1
3	No. of stem per plant	RMDSG-4 x CK-2, RMDSG-3 X CK-2	RMDSG-4 x CK-2, RMDSG-3 X CK-2	RMDSG-4 x CK-2
4	Fruit length (cm.)	AJSG-1 x CK-2, AMBIKA13-5 X AJSG-2	AJSG-1 x CK-2, AJSG-1 x IK-1	-
5	Ovary length (cm.)	NDM-2 x IK-1, NDM-2 X AJSG-2	NDM-2 x IK-1, NDM-2 X AJSG-2	AMBIKA13-6 X AJSG-2
6	Ovary diameter (cm.)	RMDSG-4 x AJSG-2, NDM-5 X CK-2	RMDSG-4 x AJSG-2, RMDSG-3 X AJSG-2	RMDSG-4 x AJSG-2
7	Fruit diameter (cm.)	NDM-5 x AJSG-2, AJSG-1 X AJSG-2	NDM-5 x AJSG-2, AJSG-1 X AJSG-2	NDM-5 x AJSG-2
8	Single fruit weight (g.)	NDM-5 x AJSG-2, AMBIKA 13-5 x CK-2	NDM-5 x AJSG-2, AMBIKA 13-5 x CK-2	-
9	No. of fruit per plant	RMDSG-4 X IK-1, NDM-2 X AJSG-2	NDM-2 x CK-2, NDM-2 X AJSG-2	RMDSG-4 X IK-1, AMBIKA13-6 X IK-1
10	Fruit yield (q/ha.)	RMDSG-4 X AJSG-2, NDM-5 X AJSG-2	NDM-5 x AJSG-2, NDM-2 X AJSG-2	RMDSG-4 x AJSG-2

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