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# Heterosis for Yield and Yield attributes in Bittergourd (*Momordica charantia* L.)

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**A B S T R A C T**

An experiment was conducted during kharif, 2012 and summer, 2013 at Vegetable Research Station, Rajendranagar, Dr.YSR Horticultural University. Five parental lines and their 10 cross combinations of bitter gourd obtained from half diallel were studied to investigate extent of heterosis for yield and yield contributing traits. In order of merit F1 hybrids as per standard heterosis, RNMC-52 X RNMC-55 (25.90%), RNMC-54 X RNMC-55 (19.05%) and RNMC-51 X RNMC-53 (9.92%) were recorded to be best promising F1 hybrids for fruit yield per vine.

## Introduction

Bitter gourd (*Momordica charantia* L.) is one of the most nutritive cucurbitaceous vegetables valued for its medicinal properties. It has been identified as one of the promising vegetable for export by Agricultural Processed Food Products and Export Development Authority (APEDA). In India, bitter gourd occupies 6.76 million hectare with the annual production of 101.43 million tonnes (Rai and Pandey, 2007). But, the demand is likely to rise to 193 million tonnes by the year 2030. The crop is cross pollinated due to monoecy. Exploitation of heterosis is far easier in cross pollinated crops like bitter gourd, provides ample scope for utilization of hybrid vigour on commercial scale. The present investigation was therefore, was under taken to study the nature and magnitude of heterosis in bitter gourd for yield and attributing traits by half diallel design.

## Material and Methods

The experiment was carried out during *kharif*, 2012 and *summer*, 2013 at Vegetable Research Station, Rajendranagar, Dr. Y S R Horticultural University. Ten $F_1$ hybrids resulting from the half diallel matting of five genetically diverse parents were evaluated for heterosis in Randomised Block Design with three replications. Observations recorded on fourteen quantitative traits *viz.*, days to first

pistillate flower appearance, node of first pistillate flower appearance, days to first fruit harvest, days to last fruit harvest, fruit length (cm), fruit diameter (cm), fruit flesh thickness (mm), average fruit weight (g), number of fruits per vine, fruit yield per vine (kg), number of primary branches per vine, vine length (m), internodal length (cm) and number of seeds per fruit. The $F_1$ hybrid Palee, released by East –West International Seeds was used as commercial check for estimation of standard heterosis. Heterosis over mid parent, better parent and commercial check, were computed following standard statistical procedures.

## Results and Discussion

The results obtained in the present study pertaining to heterotic behaviour for yield and yield components are discussed here under.

The *per se* performance of parents, hybrids and commercial check for 14 quantitative characters studied are presented in Table 1.The overall mean of parents and cross combinations revealed that hybrids registered superior performance than the parents with respect to days to first pistillate flower appearance (53.27), node of first pistillate flower appearance(12.85), days to first fruit harvest (70.63), days to last fruit harvest (106.70), fruit length (14.41cm), fruit diameter (3.18 cm), fruit flesh thickness (5.30 mm), average fruit weight (67.10 g), number of fruits per vine (19.09), fruit yield per vine (1.27kg), number of primary branches per vine (6.15) and vine length (3.30 m) in desirable direction. The cross combinations have recorded intermediate values when compared to their parents which may be attributed to inter allelic gene actions. Most of the crosses exhibited high *per se* performance than parents involved.

Among parents, RNMC-55 registered highest *per se* performance for number of fruits (26.77), fruit yield per vine (1.35 kg), fruit flesh thickness (4.67mm), number of primary branches per vine (6.50) and vine length (3.36 m). The parent RNMC-53 recorded highest *per se* performance for days to first pistillate flower appearance (48.72), node of first pistillate flower appearance (10.39) and days to first fruit harvest (67.43). The highest *per se* performance for fruit length (16.37 cm) and average fruit weight (70.27 g) was recorded by RNMC-52. The parent RNMC-51 recorded highest *per se* performance for days to last fruit harvest (108.6) and fruit diameter (3.26 cm). The top four promising crosses for fruit yield per vine were RNMC-53 X RNMC-55 (1.60 kg), RNMC-52 X RNMC-55 (1.54 kg), RNMC-54 X RNMC-55 (1.46 kg) and RNMC-51 X RNMC-53 (1.35 kg).

Heterosis was estimated for yield and yield contributing characters in 10 hybrids and was expressed as increase or decrease over mid parental (MP) value as relative heterosis, over better parent (BP) as heterobeltiosis and over two commercial check (Palee) as standard heterosis. The results are presented in the Table. The estimates of heterosis, heterobeltiosis and standard heterosis were found to be highly variable among different crosses for all characters in the present study.

Heterosis in negative direction is considered to be desirable for days to first pistillate flower appearance. Relative heterosis ranged from -6.08 (RNMC-52 X RNMC-55) to 5.61 per cent (RNMC-53 X RNMC-54). Significant negative relative heterosis was recorded in six hybrids. In hybrids, heterobeltiosis ranged from -11.52 (RNMC-51 X RNMC-53) to 1.12 per cent (RNMC-53 X RNMC-54). Eight hybrids showed significant desirable heterobeltiosis. Standard heterosis ranged from -7.31 (RNMC-52 X RNMC-53) to 4.50 per cent (RNMC-51 X RNMC-52). Among 10 hybrids studied, two hybrids exhibited significantly desirable standard heterosis.

**Table.1** Mean performance of Parents and Hybrids for fourteen quantitative characters in bitter gourd

| Parent / hybrid | Days to first pistillate flower | Node of first pistillate flower | Days to first fruit harvest | Days to last fruit harvest | Fruit length (cm) | Fruit diameter (cm) | Fruit flesh thickness (mm) | Average fruit weight (gm) | Number of fruits per vine | Fruit yield per vine (kg) | Number of primary branches per vine | Vine length (m) | Internodal length (cm) | Number of seeds per fruit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parents** | | | | | | | | | | | | | | |
| RNMC-51 | 60.55 | 17.00 | 80.48 | 108.60 | 13.19 | 3.26 | 4.93 | 66.07 | 14.30 | 0.94 | 4.60 | 2.82 | 6.72 | 20.97 |
| RNMC-52 | 55.66 | 11.37 | 74.40 | 103.12 | 16.37 | 2.63 | 4.16 | 70.27 | 15.75 | 1.11 | 5.97 | 3.32 | 6.03 | 20.87 |
| RNMC-53 | 48.72 | 10.39 | 67.43 | 96.40 | 11.29 | 2.90 | 4.33 | 57.33 | 15.72 | 0.90 | 4.44 | 2.78 | 4.72 | 14.63 |
| RNMC-54 | 53.25 | 12.66 | 72.40 | 98.93 | 13.18 | 2.66 | 4.87 | 66.80 | 12.72 | 0.87 | 4.74 | 2.98 | 4.39 | 18.16 |
| RNMC-55 | 55.44 | 13.11 | 73.48 | 107.51 | 10.83 | 2.97 | 5.05 | 51.20 | 26.77 | 1.35 | 6.50 | 3.36 | 4.73 | 15.73 |
| **Hybrids** | | | | | | | | | | | | | | |
| RNMC-51 X 52 | 55.57 | 13.08 | 1.57 | 104.65 | 15.18 | 3.42 | 5.17 | 69.73 | 16.17 | 1.13 | 6.32 | 3.02 | 5.59 | 25.43 |
| RNMC-51 X 53 | 53.58 | 13.94 | 68.33 | 109.65 | 13.29 | 3.23 | 5.53 | 66.90 | 20.17 | 1.35 | 6.44 | 3.43 | 6.11 | 18.52 |
| RNMC-51 X 54 | 54.39 | 16.72 | 71.50 | 105.30 | 13.79 | 2.90 | 4.98 | 69.37 | 14.60 | 1.01 | 4.76 | 3.35 | 6.38 | 23.33 |
| RNMC-51 X 55 | 54.80 | 14.80 | 73.25 | 107.13 | 11.90 | 3.47 | 6.15 | 65.43 | 19.60 | 1.28 | 6.90 | 3.50 | 6.33 | 15.88 |
| RNMC-52 X 53 | 49.29 | 9.85 | 68.32 | 105.11 | 15.20 | 2.59 | 4.37 | 60.45 | 20.45 | 1.24 | 6.40 | 3.26 | 4.61 | 17.43 |
| RNMC-52 X 54 | 54.34 | 12.61 | 72.23 | 100.60 | 19.40 | 2.67 | 4.26 | 77.10 | 12.47 | 0.96 | 5.65 | 2.86 | 4.84 | 25.50 |
| RNMC-52 X 55 | 52.17 | 14.72 | 69.41 | 112.03 | 13.73 | 3.27 | 5.28 | 70.90 | 21.80 | 1.54 | 6.88 | 3.74 | 5.59 | 22.21 |
| RNMC-53 X 54 | 53.84 | 11.11 | 71.33 | 102.84 | 12.70 | 2.94 | 5.09 | 64.59 | 17.10 | 1.10 | 5.32 | 3.16 | 5.24 | 18.27 |
| RNMC-53 X 55 | 53.65 | 11.41 | 70.69 | 109.16 | 12.72 | 3.50 | 6.10 | 64.99 | 24.77 | 1.60 | 6.57 | 3.25 | 4.64 | 19.15 |
| RNMC-54 X 55 | 51.08 | 10.28 | 69.68 | 110.50 | 16.16 | 3.79 | 6.02 | 61.49 | 23.77 | 1.46 | 6.24 | 3.40 | 6.13 | 22.34 |
| **Check** | | | | | | | | | | | | | | |
| Palee | 53.17 | 11.72 | 72.93 | 104.64 | 18.62 | 3.65 | 6.14 | 84.87 | 14.50 | 1.23 | 6.65 | 3.44 | 6.69 | 26.50 |

**Table.2** Heterosis (%) over mid parent for fourteen quantitative characters in bitter gourd

| Hybrids | Days to first pistillate flower | Node of first pistillate flower | Days to first fruit harvest | Days to last fruit harvest | Fruit length (cm) | Fruit diameter (cm) | Fruit flesh thickness (mm) | Average fruit weight (gm) | Number of fruits per vine | Fruit yield per vine (kg) | Number of primary branches per vine | Vine length (m) | Internodal length (cm) | Number of seeds per fruit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RNMC-51 X 52 | -4.37** | -7.76 | -7.58** | -1.14 | 2.71 | 15.88** | 13.67** | 2.30 | 7.59 | 9.89** | 19.60** | -1.74 | -12.37** | 21.55 * |
| RNMC-51 X 53 | -1.93 | 1.83 | -7.60** | 6.98** | 8.64** | 4.76* | 19.28** | 8.43** | 34.37** | 46.21** | 42.55** | 22.50** | 6.85 | 4.01 |
| RNMC-51 X 54 | -4.42** | 12.73 ** | -6.46** | 1.48 | 4.63 | -2.02 | 1.50 | 4.43** | 8.08 | 11.62** | 2.00 | 15.40** | 14.95** | 19.24** |
| RNMC-51 X 55 | -5.51** | -1.66 | -4.84** | -0.86 | -0.89 | 11.23** | 23.25** | 11.60** | -4.55 | 11.50** | 24.46** | 13.10** | 10.57** | -13.46** |
| RNMC-52 X 53 | -5.57** | -9.44 | -3.67** | 5.36** | 9.93** | -6.56** | 2.79 | -5.25** | 29.99** | 23.21** | 22.96** | 6.99 | -14.26** | -1.80 |
| RNMC-52 X 54 | -0.21 | 4.95 | -1.59 | -0.42 | 31.32** | 0.82 | -5.72* | 12.50** | -12.42** | -2.77 | 5.57 | -9.31** | -7.01 | 30.65** |
| RNMC-52 X 55 | -6.08** | 20.29 ** | -6.12** | 6.38** | 0.98 | 16.72** | 14.73** | 16.74** | 2.54 | 25.57 ** | 10.35** | 11.82** | 3.90 | 21.34** |
| RNMC-53 X 54 | 5.61** | -3.60 | 2.03 | 5.30** | 3.84 | 5.63* | 10.64** | 4.06* | 20.28** | 24.36** | 15.83** | 9.97** | 15.11** | 11.39** |
| RNMC-53 X 55 | 3.02* | -2.81 | 0.33 | 7.07** | 15.04** | 19.18** | 30.14** | 19.75** | 16.59** | 42.74** | 20.05** | 5.81 | -1.83 | 26.10** |
| RNMC-54 X 55 | -6.00** | -20.24** | -4.46** | 7.05** | 34.62** | 34.44** | 21.44** | 4.23* | 20.39** | 31.42** | 11.16** | 7.42* | 34.48** | 31.81** |
| SEd± | 0.65 | 0.57 | 0.76 | 0.77 | 0.38 | 0.06 | 0.11 | 0.91 | 0.51 | 0.025 | 0.15 | 0.09 | 0.17 | 0.57 |

*Significant at 5% level, ** Significant at 1%level

**Table.3** Heterosis (%) over better parent for fourteen quantitative characters in bitter gourd

| Hybrids | Days to first pistillate flower | Node of first pistillate flower | Days to first fruit harvest | Days to last fruit harvest | Fruit length (cm) | Fruit diameter (cm) | Fruit flesh thickness (mm) | Average fruit weight (gm) | Number of fruits per vine | Fruit yield per vine (kg) | Number of primary branches per vine | Vine length (m) | Internodal length (cm) | Number of seeds per fruit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RNMC-51 X 52 | -8.24** | -23.04** | -11.07** | -3.63** | -7.27* | 4.70 | 4.80 | -0.76 | 2.62 | 1.84 | 5.87 | -9.13 * | -16.87** | 21.27 ** |
| RNMC-51 X 53 | -11.52** | -17.98** | -15.09** | 0.97 | 0.81 | -1.02 | 12.03** | 1.26 | 28.31** | 42.83** | 40.17** | 21.49 ** | -9.03** | -11.71 ** |
| RNMC-51 X 54 | -10.18** | -1.65 | -11.15** | -3.04** | 4.60 | -11.03** | 0.88 | 3.85* | 2.10 | 7.17* | 0.49 | 12.43 ** | -5.01 | 11.25 ** |
| RNMC-51 X 55 | -9.51** | -12.92** | -8.98** | -1.35 | -9.73** | 6.23** | 21.86** | -0.96 | -26.77** | -5.37* | 6.26* | 4.07 | -5.80 | -24.27 ** |
| RNMC-52 X 53 | -11.46** | -13.34* | -8.18** | 1.93 | -7.13* | -10.91** | 0.77 | -13.97** | 29.83** | 11.75** | 7.26* | -1.81 | -23.55** | -16.48 ** |
| RNMC-52 X 54 | -2.37 | -0.42 | -2.91 * | -2.44** | 18.53** | 0.25 | -12.59** | 9.72** | -20.86** | -13.20** | -5.31 | -14.04 ** | -19.68** | 22.17 ** |
| RNMC-52 X 55 | -6.28 ** | 12.31* | -6.71** | 4.21** | -16.09** | 10.10** | 4.69 | 0.90 | -18.56** | 14.09 ** | 5.85 | 11.21 ** | -7.30 | 6.40 |
| RNMC-53 X 54 | 1.12 | -12.27* | -1.47 | 3.96** | -3.62 | 1.26 | 4.51 | -3.31 | 8.80* | 22.18** | 12.24** | 6.27 | 11.01 * | 0.57 |
| RNMC-53 X 55 | -3.22 * | -12.89* | -3.80** | 1.54 | 12.73** | 17.85** | 20.94** | 13.35** | -7.47** | 18.84** | 1.08 | -3.37 | -1.90 | 21.69 ** |
| RNMC-54 X 55 | -7.86 ** | -21.59** | -5.16** | 2.78** | 22.64 ** | 27.50** | 19.35** | -7.94** | -11.21** | 7.88** | -3.90 | 1.29 | 29.60** | 23.00 ** |
| SEd± | 0.76 | 0.66 | 0.88 | 0.89 | 0.44 | 0.07 | 0.13 | 1.06 | 0.59 | 0.029 | 0.18 | 0.11 | 0.20 | 0.66 |

*Significant at 5% level, ** Significant at 1%level

**Table.4** Heterosis (percent) over standard check for fourteen quantitative traits in bitter gourd

| Hybrids | Days to first pistillate flower | Node of first pistillate flower | Days to first fruit harvest | Days to last fruit harvest | Fruit length (cm) | Fruit diameter (cm) | Fruit flesh thickness (mm) | Average fruit weight (gm) | Number of fruits per vine | Fruit yield per vine (kg) | Number of primary branches per vine | Vine length (m) | Internodal length (cm) | Number of seeds per fruit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RNMC-51X52 | 4.50** | 11.63 | -1.87 | 0.01 | -18.48** | -6.39** | -15.84** | -17.83** | 11.49** | -8.18 ** | -5.06 | -12.29** | -16.49** | -4.03 |
| RNMC-51X53 | 0.76 | 18.97** | -6.3** | 4.79 ** | -28.59** | -11.51** | -10.04** | -21.17** | 39.08** | 9.92** | -3.16 | -0.39 | -8.62 ** | -30.13** |
| RNMC-51X54 | 2.28 | 42.66** | -1.97 | 0.63 | -25.91** | -20.46** | -18.99** | -18.26** | 0.69 | -17.53** | -28.46** | -2.81 | -4.58 | -11.95** |
| RNMC-51X55 | 3.05 | 26.31** | 0.43 | 2.38 ** | -36.06** | -5.02* | 0.11 | -22.90** | 35.17** | 4.43 | 3.76 | 1.55 | -5.38 | -40.06** |
| RNMC-52 53 | -7.31** | -15.96** | -6.33** | 0.45 | -18.35** | -29.13** | -28.92** | -28.77** | 41.06** | 0.76 | -3.81 | -5.23 | -31.09** | -34.21** |
| RNMC-52X54 | 2.20 | 7.59 | -0.96 | -3.86** | 4.21 | -26.85** | -30.66** | -9.15** | -14.02** | -21.74** | -15.08** | -17.04** | -27.60** | -3.77 |
| RNMC-52X55 | -1.89 | 25.60** | -4.83** | 7.06** | -26.23** | -10.41** | -14.00** | -16.46** | 50.34** | 25.90** | 3.36 | 8.52* | -16.44** | -16.19 ** |
| RNMC-53X54 | 1.26 | -5.20 | -2.19 | -1.72 | -31.76** | -19.45** | -17.09** | -23.90** | 17.93** | -10.33** | -20.09** | -8.13* | -21.62** | -31.07 ** |
| RNMC-53X55 | 0.90 | -2.59 | -3.08* | 4.32** | -31.66** | -4.11 | -0.65 | -23.42** | 70.80** | 31.14** | -1.30 | -5.71 | -30.64** | -27.75 ** |
| RNMC-54X55 | -3.94* | -12.32 | -4.46** | 5.60** | -13.18** | 3.74 | -1.95 | -27.54** | 63.91** | 19.05** | -6.16* | -1.16 | -8.37* | -15.70 ** |
| SE (d) | 0.76 | 0.66 | 0.88 | 0.89 | 0.44 | 0.07 | 0.13 | 1.06 | 0.59 | 0.029 | 0.18 | 0.11 | 0.20 | 0.66 |

*Significant at 5% level, ** Significant at 1%level

Heterosis in negative direction is considered to be desirable for node of first pistillate flower appearance. The relative heterosis ranged from -20.24 per cent (RNMC-54 X RNMC-55) to 20.29% (RNMC-52 X RNMC-55). Negatively significant relative heterosis was noticed in only one out of 10 hybrids. The heterobeltiosis was ranged from -23.04 (RNMC-51 X RNMC-52) to 12.31 per cent (RNMC-52 X RNMC-55) with seven hybrids showing negatively significant heterobeltiosis. The range of standard heterosis was from -15.96 (RNMC-52 X RNMC-53) to 42.66 per cent (RNMC-51 X RNMC-54). Out of 10 hybrids only one hybrid (RNMC-52 X RNMC-53) exhibited significant standard heterosis in desirable direction.

Heterosis in negative direction is considered to be desirable for days to first fruit harvest. The relative heterosis ranged from -7.60 (RNMC-51 X RNMC-53) to 2.03 per cent (RNMC-53 X RNMC-54). The range of heterobeltiosis was from -15.09 (RNMC-51 X RNMC-53) to -2.91 per cent (RNMC-52 X RNMC-54). Significant negative relative heterosis and heterobeltiosis were exhibited by seven and nine hybrids, respectively. Standard heterosis ranged from -6.33 (RNMC-51 X RNMC-53) to 0.43 per cent (RNMC-51 X RNMC-55). Five hybrids exhibited significant negative standard heterosis.

Relative heterosis ranged from -1.14 (RNMC-51 X RNMC-52) to 7.07 per cent (RNMC-53 X RNMC-55) with six hybrids registered positively significant relative heterosis. Heterobeltiosis ranged from -3.63 (RNMC-51 X RNMC-52) to 4.21 per cent (RNMC-52 X RNMC-55) and three hybrids exhibited significantly positive heterobeltiosis. Standard heterosis ranged from -3.86 (RNMC-52 X RNMC-54) to 7.06 per cent (RNMC-52 X RNMC-55). Five of ten hybrids showed significant positive standard heterosis.

Relative heterosis ranged from -0.89 (RNMC-51 X RNMC-55) to 34.62 per cent (RNMC-54 X RNMC-55) with five hybrids registered positively significant relative heterosis. Heterobeltiosis ranged from -16.09 (RNMC-52 X RNMC-55) to 22.64 per cent (RNMC-54 X RNMC-55) and three of the hybrids exhibited significantly positive heterobeltiosis. Standard heterosis ranged from -36.06 (RNMC-51 X RNMC-55) to 4.21 percent (RNMC-52 X RNMC-54). Among 10 hybrids, none of them recorded significantly positive standard heterosis.

Relative heterosis ranged from -6.56 (RNMC-52 X RNMC-53) to 34.44 per cent (RNMC-54 X RNMC-55) with seven hybrids registering positively significant relative heterosis. Heterobeltiosis ranged from -11.03 (RNMC-51 X RNMC-54) to 27.50 per cent (RNMC-54 X RNMC-55) and four of the hybrids exhibited significantly positive heterobeltiosis. Standard heterosis ranged from -29.13 per cent (RNMC-52 X RNMC-53) to 3.74 per cent (RNMC-54 X RNMC-55). None of the hybrids recorded significantly positive standard heterosis over Palee.

Magnitude of heterosis over mid parent, better parent and commercial check was significant in both the directions. Maximum positive heterosis was observed over mid parent in the cross RNMC-53 X RNMC-55 (30.14%) followed by RNMC-51 X RNMC-55 (23.25%). Eight hybrids recorded positive significant relative heterosis. Maximum positive and significant heterosis over better parent was observed in the cross RNMC-51 X RNMC-55 (21.86%) followed by RNMC-53 X RNMC-55 (20.94%). Out of 10 hybrids, 3 exhibited positive and significant heterobeltiosis. None of the crosses recorded significant positive standard heterosis over Palee.

Relative heterosis ranged from -5.25 (RNMC-52 X RNMC-53) to 19.75 per cent (RNMC-53 X RNMC-55). Significant positive relative heterosis was recorded in 8 hybrids for average fruit weight. Heterobeltiosis ranged from -13.97 (RNMC-52 X RNMC-53) to 13.35 per cent (RNMC-53 X RNMC-55) and 3 hybrids exhibited significant positive heterobeltiosis. The standard heterosis ranged from -28.77 (RNMC-52 X RNMC-53) to -9.15 per cent (RNMC-52 X RNMC-54). Among 10 hybrids, none recorded significant positive standard heterosis.

The range of relative heterosis was from -12.42 (RNMC-52 X RNMC-54) to 34.37 per cent (RNMC-51 X RNMC-53) with 5 hybrids exhibiting significant positive relative heterosis. The heterobeltiosis ranged from -26.77 (RNMC-51 X RNMC-55) to 29.83% (RNMC-52 X RNMC-53) and three hybrids recorded positive significant heterobeltiosis. Standard heterosis ranged from -14.02 (RNMC-52 X RNMC-54) to 70.80 % (RNMC-53 X RNMC-55). Among 10 hybrids, eight recorded significantly positive standard heterosis for number of fruits per vine.

Magnitude of heterosis over mid parent, over better parent and commercial check was highly significant. Maximum positive heterosis over the mid parent was observed in the cross RNMC-51 X RNMC-53 (46.21%) followed by RNMC-53 X RNMC-55(42.74%). Maximum positive and significant heterosis over the better parent was observed in the cross RNMC-51 X RNMC-53 (42.83%) followed by RNMC-53 X RNMC-54(22.18). Maximum positive and significant standard heterosis was observed in the cross RNMC-53 X RNMC-55 (31.14%) followed by RNMC-52 X RNMC-55 (25.90%) and RNMC-54 X RNMC-55 (19.05%) over standard check. Out of 10 crosses, 9 crosses over mid parent, 7 crosses over the better parent and 4 crosses over check showed positive and significant heterosis for the trait under consideration.

Maximum positive heterosis over mid parent was observed in the cross RNMC-51 X RNMC-53 (42.55%) and minimum was in cross RNMC-51 X RNMC-54 (2.00%). Out of 10 crosses eight exhibited positive significant heterosis over mid parent. Highest heterosis over the better parent was observed in the cross RNMC-51 X RNMC-53 (40.17%) and minimum heterobeltiosis was observed in the cross RNMC-52 X RNMC-54. None of the hybrids recorded positive significant heterosis over check.

The range of relative heterosis was from -9.31 (RNMC-52 X RNMC-54) to 22.50 per cent (RNMC-51 X RNMC-53) with 6 hybrids exhibiting significant positive relative heterosis. The heterobeltiosis ranged from -14.04 (RNMC-52 X RNMC-54) to 21.49% (RNMC-51 X RNMC-53) and 3 hybrids recorded positive significant heterobeltiosis. Standard heterosis ranged from -17.04 (RNMC-52 X RNMC-54) to 8.52 % (RNMC-52 X RNMC-55) over standard check. Among 10 hybrids, only one hybrid (RNMC-52 X RNMC-55) recorded significant positive standard heterosis for vine length over the check.

Heterosis in negative direction is considered to be desirable for internodal length. Magnitude of heterosis over mid parent, better parent and commercial check was highly significant in both the directions. Maximum negative and significant heterosis over the mid parent was observed in the cross RNMC-52 X RNMC-53 (-14.26%), over the better parent is in the cross RNMC-52 X RNMC-53(-23.25%) and over the commercial check is in the cross RNMC-52 X RNMC-53 (-31.09%). Out of 10 crosses, 2 crosses over mid parent and 4 crosses over better parent showed negative and significant heterosis for internodal length. Among 10 hybrids, eight

exhibited significant standard heterosis in desired direction (negative).

Heterosis in negative direction is considered to be desirable for the trait number of seeds per fruit. The hybrid RNMC-51 X RNMC-55 recorded highest significant negative heterosis over mid parent (-13.46%), better parent (-22.27%) and check (-40.06%). Eight hybrids recorded negative and significant heterosis over the check Palee.

The maximum standard heterosis for number of fruits per vine was observed in RNMC-54 X RNMC-55 (70.80%) followed by RNMC-54 X RNMC-55 (62.79%), RNMC-52 X RNMC-55 (49.32%) and RNMC-52 X RNMC-53(41.06%). The standard heterosis for fruit yield per vine was higher in RNMC-52 X RNMC-55(25.90%), RNMC-54 X RNMC-55 (19.05%) and RNMC-51 X RNMC-53 (9.92%). The results are in conformity with the results of Singh et al. (2000), Tewari et al. (2001), Sundaram (2008), Jadav et al. (2009) and Thangamani et al. (2011). It could be concluded from the above investigation that the cross combinations RNMC-53 × RNMC-55 (31.19%) and RNMC-52 × RNMC-55 (25.90%) exhibited high standard heterosis for fruit yield per vine can be further tested in large scale yield trails before recommending for commercial cultivation.

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