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# Assessment of Heterosis in Inter-varietal Hybrids of Mangalore Melon (*Cucumismelo* var. *acidulus*) for Yield and Quality Traits

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**Abstract**

Mangalore melon is one of the distinct class of Cucurbitaceae family widely grown in southern part of India. Despite of having many nutritional values, there is scope for systematic hybridization study to improve the many qualitative and quantitative traits. An investigation was undertaken to develop inter-varietal hybrids and their evaluation to assess the extent of heterosis in newly developed hybrids between selected genotypes of Mangalore melon during *kharif,* 2019 and 2020 at College of Horticulture, Sirsi, Karnataka, India. A total of 16 intervarietal hybrids were developed by crossing 15 parental lines. Hybrids were developed using hand emasculation and hand pollination technique and the developed hybrids were evaluated using RCBD design with two replications. The results showed significant positive heterosis over mid parent and better parent for all the hybrids. The hybrids Soubhagya×RNMS-1 exhibited highest and significant heterosis over both mid parent (88.05%) and better parent (72.69%) followed by MS-19×MS-5 over mid parent (73.09%) and better parent (61.10%). From this study, it was concluded that hybrid Soubhagya×RNMS-1 was superior over their parents for most of the traits with the total yield of 8.44 kg plant$^{-1}$. These best performing hybrids are need to be studied for their stability and commercial exploitation, resistance of pest and diseases, keeping quality of hybrids (storability) and experimentation on hybrid seed production technologies as well as storability of seeds should be done.

***Keywords:*** Mangalore melon, intervarietal hybrids, heterosis, yield and quality traits

## 1. Introduction

Mangalore melon or culinary melon (*Cucumis melo Subspp agrestis* var. *acidulus*) is one among the non-dessert melon group vegetable belonging to the family Cucurbitaceae and the genus cucumis with a diploid chromosome number of 2n=2x=24 (Pitrat, 2008). Mangalore melon (*Cucumis melo* var. *acidulus*) is grown in South Indian states viz., Karnataka, Kerala, Andhra Pradesh, Telangana and Tamil Nadu in Malnad and coastal regions. In Kerala its known by locally as Vellari, kanivellari; In Andhra Pradesh and Telangana as dosakaya and in TamilNadu as Madras cucumber, Malbar cucumber. (Swamy and Premnath, 2020; Silpa et al., 2019; Shet et al., 2021a; Shet et al., 2024).

Mangalore melons are used in an array of traditional dishes like curry, sambar, soup, daal, chutney, and also in making dosa and aavakaaya (Indian pickles). Even its small and edible seeds are used for the preparation of juice, which is known for treating dyspepsia, and it is a good source of dietary fiber. Fruits are varying in size, color, and shape, with smooth, tender skin, moisture-rich, white flesh usually with little sweetness and odor (Shet et al., 2024). It possesses cooling properties and is used as a skin moisturizer and digestive agent (Swamy and Premnath, 2020). It is effective in reducing constipation and protecting against colon cancers. Seeds also have medicinal values, as juice from them can help cure dyspepsia. (Suzanne, 2016). The fruits are large and

botanically known as pepo. The crop best thrives in warm weather with bright sunlight (Shet et al., 2021a) and also in rainfed, irrigated, and rice fallow areas after harvest of the *kharif* crop using residual moisture from paddy fallows, as well as in the summer season. Its short-duration vegetable starts economic yield after 45 days of sowing and completes its life span in 70–75 days with three to four harvests. Mangalore melon is moderately resistant to downey mildew and powdery mildew during the *kharif* season compared to muskmelon and cucumber, which show susceptibility to the above diseases. (Shet et al., 2021b)

In Karnataka, Mangalore melon is popularized with many vernacular names such as sambar southe, Mangalore southe, moggekayi. Typically these Mangalore/culinary melons are classified as var. *acidulus* group under subspecies *agrestis* and species *melo* (Gunnaiah et al., 2021: Swamy and Premnath, 2020; Virupakshi et al., 2023). Short duration, photo-insensitive, wide culinary use and high shelf life of fruits attracts farmers for cultivation. There is a limited cultivation of Mangalore melon in Karnataka as per as its area and productivity is concerned. However the crop has high diversity and found to be good genetic variability in the crop (Kalgudi et al., 2021 and Kumbar et al., 2021) and fruits are in various size and shape so there is need to be production of consumer preferred uniform sized fruits. The available local cultivars or varieties were low in productivity and results in reduced income to farmers. There is need to develop superior hybrids for cultivation. However, there is lack of systematic studies in hybridization and characterization of developed hybrids. Further, Mangalore melon is monoecious and highly cross pollinated in nature, and such pollination mechanism can be exploited for the development of hybrid (Soumya et al., 2023). With this background present study was conducted to exploit the heterosis in different inter-varietal hybrids of Mangalore melon. This study identified the promising hybrids for productivity traits which will serves as a base for further developing trait specific hybrids in Mangalore melon.

## 2. Materials and Methods

### *2.1. Development of inter-varietal hybrids*

The best performing 15 Mangalore melon accessions were selected from the UHSB-PNASF project and used as parents for developing hybrids during late *kharif,* 2019–2020 at Department of Biotechnology and Crop Improvement farm, College of Horticulture, Sirsi. A day prior to hybridization, flower buds of female parents were covered by butter paper bags and pollens of the male parent was dusted on the stigma of the female parents in the next day morning between 7–8 am and again covered by butter paper bags to avoid contamination. Repeated pollination was also done in the next day morning to ensure proper fruit and seed set. Every pollinated flower was bagged and labelled to avoid contamination. The hybrid fruits were harvested at their maturity time and seeds of fully matured well developed fruits were extracted, stored and used for evaluation in the subsequent season (Kalgudi et al., 2021).

### *2.2. Evaluation of hybrids and estimation of heterosis*

The newly developed 15 inter-varietal Mangalore melon hybrids were evaluated along with their parents during summer of 2020 in Randomized Complete Block Design with two replications. Drip irrigation and plastic mulching was adopted to control weed growth and efficient utilization of water. The spacing of 2 m between rows and 60 cm between plants was maintained. Five plants were selected for recording observations from each replication for the characters namely vine length at 30 and 60 days after sowing (cm), Sex ratio (%), Days to first harvest, Number of fruits vine$^{-1}$, Average fruit yield (g), Flesh thickness, Total yield vine$^{-1}$ (kg), Fruit length (cm), fruit width (cm) and TSS ($^{o}$Brix). Mean data of replications of both parents and hybrids were used for calculating mean performance.With the help of heterosis formulae given by Jinks and Jones (1958), the superiority of newly developed hybrids was assessed over their mid parent (MP) and better parent (BP) value.

## 3. Results and Discussion

### *3.1. Mean performance of parents and hybrids*

The mean performance of parents for growth, yield and quality traits were presented in Table 1. At 60 DAS, vine length ranged from 110 cm to 199 cm in parents, minimum being observed in MS-30 and maximum in MS-15. For sex ratio, the number of male flowers to female flowers MS-39 was showed minimum (9.80) and MS-31 showed maximum (16.65) percentage. The minimum number of days for first picking was recorded in MS-21 (56) followed by MS-74 (57) and longer duration for first picking in MS-15 (66). For number of fruits vine$^{-1}$, it was reported minimum (3) in MS-19 and maximum (6) in parent MS-5 followed by MS-2 (5). Average fruit weight of different genotypes has the range of 237.17 g to 914 g. Minimum was found in MS-5 and maximum in Soubhagya. Among parents, highest yield plant$^{-1}$ was observed in MS-2 (4.21 kg) followed by soubhagya (3.79 kg) and lowest yield was found in MS-5 (1.35 kg). With respect to fruit parameters, highest fruit length was found in parent MS-30 (25.14 cm ) and the lowest was in MS-15 (10.82 cm) and the fruit width is ranged from 7.05 cm (MS-5) to 12.12 (MS-39). TSS like quality parameter analysis in parents reveals that high TSS was observed in the fruits of parent MS-28 (5.22$^{\circ}$B) and the least TSS was found in MS-2 (2.46$^{\circ}$B).

There is a significant difference in the mean performance of hybrids for different growth, yield and quality parameters (Table 2) . For vine length at 60 DAS, the growth of vine length ranged from 128 cm (MS-17×MS-30) to 272 cm (Soubhagya× RNMS-1). In hybrids the sex ratio was ranged from 8.40 (MS-2 ×RNMS-1) to 13.35 (SS-17×MS-2). For days to first harvest, the hybrids were come to early harvest compare to their parents.

Among newly developed hybrids Soubhagya×RNMS-1 was

Table 1: Mean performance of parents used in hybridization for yield and quality traits

| Parents | VL @ 60 DAS | SR | DH | NFPV | AFW | TYV | FL | FW | TSS |
|---|---|---|---|---|---|---|---|---|---|
| MS-5 | 177.00 | 13.45 | 64.00 | 6.00 | 237.17 | 1.35 | 16.00 | 7.05 | 2.72 |
| MS-2 | 193.00 | 11.40 | 63.00 | 5.00 | 905.17 | 4.21 | 24.57 | 7.67 | 2.46 |
| MS-15 | 199.00 | 12.85 | 66.00 | 4.00 | 590.50 | 2.15 | 10.82 | 7.89 | 3.35 |
| MS-30 | 110.00 | 13.90 | 65.00 | 4.00 | 905.00 | 3.16 | 25.14 | 8.95 | 4.50 |
| MS-31 | 167.00 | 16.65 | 62.00 | 3.00 | 691.67 | 2.38 | 18.50 | 9.84 | 4.27 |
| MS-28 | 139.00 | 15.30 | 57.00 | 4.00 | 870.33 | 3.05 | 19.53 | 9.45 | 5.22 |
| MS-19 | 158.00 | 14.48 | 61.00 | 3.00 | 653.83 | 2.18 | 18.57 | 9.95 | 3.20 |
| MS-39 | 172.00 | 9.80 | 60.00 | 4.00 | 469.67 | 1.80 | 17.45 | 9.32 | 3.22 |
| MS-34 | 130.00 | 10.40 | 61.00 | 4.00 | 458.67 | 1.70 | 16.22 | 8.73 | 2.94 |
| MS-17 | 157.00 | 13.66 | 63.00 | 4.00 | 590.69 | 2.36 | 17.17 | 8.83 | 3.09 |
| MS-21 | 175.00 | 12.53 | 56.00 | 4.00 | 900.99 | 3.30 | 18.85 | 10.02 | 3.62 |
| MS-74 | 180.00 | 13.67 | 57.00 | 4.00 | 441.83 | 1.70 | 15.29 | 7.20 | 3.38 |
| RNMS-1 | 160.00 | 16.40 | 62.00 | 4.00 | 540.17 | 2.07 | 13.87 | 9.57 | 4.50 |
| SS-17 | 175.00 | 13.07 | 59.00 | 4.00 | 838.33 | 3.66 | 19.05 | 10.82 | 3.38 |
| SOUBHAGYA | 183.00 | 10.53 | 60.00 | 4.00 | 914.17 | 3.79 | 20.72 | 9.30 | 4.37 |

VL: Vine length (cm); DAS: days after sowing ; SR: Sex ratio (%); DH: Days to first harvest; NFPV: Number of fruits vine$^{-1}$; AFW: Average fruit weight (g); TYV: Total Fruit yield vine$^{-1}$ (kg); FL: Fruit length (cm); FW: Fruit width (cm); TSS: Total soluble sugars (˚brix)

Table 2: Mean performance of inter-varietal hybrids for yield and quality traits

| Hybrids | VL @ 60 DAS | SR | DH | NFPV | AFW | TYV | FL | FW | TSS |
|---|---|---|---|---|---|---|---|---|---|
| MS-2×MS-30 | 230.00 | 11.01 | 55.00 | 6.00 | 1029.84 | 5.68 | 23.05 | 11.83 | 4.09 |
| MS-19×MS-5 | 206.00 | 11.49 | 56.00 | 5.00 | 939.33 | 4.82 | 22.17 | 8.92 | 5.57 |
| MS-17×MS-30 | 128.00 | 11.49 | 55.00 | 6.00 | 765.00 | 4.54 | 19.52 | 10.62 | 5.12 |
| MS-74×MS-30 | 170.00 | 11.60 | 56.00 | 5.00 | 762.33 | 3.75 | 18.42 | 9.15 | 4.20 |
| MS-2×MS-15 | 213.00 | 10.86 | 57.00 | 5.00 | 736.00 | 3.57 | 21.53 | 9.98 | 4.54 |
| MS-19×MS-2 | 174.00 | 9.58 | 60.00 | 5.00 | 932.50 | 4.50 | 22.72 | 12.80 | 1.57 |
| MS-31×MS-30 | 213.00 | 11.01 | 55.00 | 5.00 | 387.17 | 1.82 | 17.00 | 7.39 | 5.30 |
| MS-34×MS-30 | 191.00 | 12.25 | 56.00 | 5.00 | 552.50 | 2.60 | 16.53 | 8.27 | 3.63 |
| SS-17×MS-2 | 181.00 | 13.35 | 56.00 | 6.00 | 830.50 | 4.71 | 18.58 | 9.95 | 3.65 |
| SS-17×RNMS-1 | 176.00 | 10.58 | 61.00 | 5.00 | 920.83 | 4.25 | 22.74 | 9.88 | 5.17 |
| MS-28×RNMS-1 | 152.00 | 9.85 | 59.00 | 5.00 | 777.34 | 3.74 | 17.70 | 10.47 | 4.20 |
| MS-2×RNMS-1 | 194.00 | 8.59 | 61.00 | 6.00 | 573.67 | 3.40 | 17.20 | 9.23 | 6.29 |
| MS-39×RNMS-1 | 202.00 | 10.57 | 57.00 | 5.00 | 779.83 | 4.28 | 17.45 | 8.83 | 4.27 |
| SOUBHAGYA×MS-5 | 200.00 | 9.91 | 57.00 | 7.00 | 631.67 | 4.19 | 19.38 | 13.57 | 5.29 |
| SOUBHAGYA×RNMS-1 | 272.00 | 8.40 | 53.00 | 7.00 | 1259.00 | 8.44 | 22.82 | 13.91 | 6.30 |
| MS-21×MS-30 | 209.00 | 10.50 | 55.00 | 6.00 | 929.67 | 3.81 | 17.78 | 7.72 | 5.29 |

VL: Vine length (cm); DAS: days after sowing ; SR: Sex ratio (%); DH: Days to first harvest; NFPV: Number of fruits vine$^{-1}$; AFW: Average fruit weight (g); TYV: Total Fruit yield vine$^{-1}$ (kg); FL: Fruit length (cm); FW: Fruit width (cm); TSS: Total soluble sugars (˚brix)

taken minimum (53) days to first harvest followed by MS-17×MS-30, MS-2×MS-30, MS-31×MS-30, MS-21×MS-30, were taken 55 days to first harvest and the highest (60.84) crop duration was observed in the hybrid SS-17×RNMS-1. In hybrids, number of fruits vine$^{-1}$ was ranged from 5 (MS-2×MS-30, MS-17×MS-30 and SS-17×MS-2, MS-2×RNMS-1, MS-21×MS-30) to 7 (Soubhagya×RNMS-1 and Soubhagya× MS-5). Among hybrids, Soubhagya×RNMS-1 was reported that having highest (1259 g) average fruit weight followed by MS-2×MS-30 (1029.84 g) and the lowest (387.17 g) average fruit weight was recorded in MS-31×MS-30. The hybrids were reported to be superior in total yield vine$^{-1}$ than that of the parents it ranges from 1.82 kg (MS-31×MS-30) to 8.44 kg (Soubhagya×RNMS-1). For fruit parameters like fruit length the hybrid, MS-2×MS-30 was recorded highest (23.05 cm) and the lowest (16.53 cm) was founded in MS-34×MS-30. The hybrid Soubhagya x RNMS-1 was recorded to have highest (13.91 cm) fruit width followed by Soubhagya×MS-5 (13.57 cm) and the minimum (7.39 cm) fruit width was observed in MS-31×MS-30. For quality parameters like TSS the hybrids were recorded its range from 1.57°B (MS-19×MS-2) to 6.30 °B (Soubhagya×RNMS-1).

*3.2. Heterosis studies in intervarietal hybrids*

Heterosis breeding is a quick, cheap and easy method of increasing the yield, quality and possesses better adaptability to the adverse environmental conditions. In practical view of plant breeding, superiority of the $F_1$ over mid parent is of little importance, since it does not offer any advantage to exploit it commercially, however the superiority over better parents makes difference in exploitation. The main objective of this study to assess the performance of newly developed intervarietal hybrids of Mangalore melon. The results of superiority of hybrids over the better and mid parent values for a number of important productivity traits were presented in Table 3. The various growth and yield traits are plays important role in increasing total productivity of the crop among such traits the vine length, sex ratio, number of fruits vine$^{-1}$, fruit length, fruit width, and quality parameter like TSS of juice has been undertaken for the study to estimate the heterosis of present investigation. For vine length at 30 DAS, magnitude of heterosis over mid and better parent was significant in both the directions. Maximum and positively significant heterosis of 70.37% over mid parent and 69.12% over better parent was reported in the cross MS-19×MS-5. Similarly vine length at 60 DAS Maximum and positively significant heterosis (59.17%) over mid parent and (48.63%) over better parent was reported in the cross (MS-34×MS-30) and (Soubhagya×RNMS-1) respectively. In the present investigation the hybrids were exhibiting positive and maximum magnitude of heterosis over its parents for growth parameters indicates that there was a good compatibility between the parents. And additive gene effects of both the parents resulted in better performance of hybrids. Fruiting of vines for a longer period and increase in the yield is strongly

Table 3: Heterosis over better parent and mid parent values for yield and quality traits

| Hybrids | VL (cm) @ 30 DAS | | VL (cm) @ 60 DAS | | SR | | DH | | NFPV | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Heterosis over | | % Heterosis over | | % Heterosis over | | % Heterosis over | | % Heterosis over | |
| | MP | BP | MP | BP | MP | BP | MP | BP | MP | BP |
| MS-2×MS-30 | 70.07* | 68.92* | 51.82* | 19.17* | -12.96* | -20.79* | -14.02* | -15.55* | 34.64* | 17.77* |
| MS-19×MS-5 | 70.37* | 69.12* | 22.99* | 16.38* | -17.72* | -20.65* | -10.73* | -12.83* | 13.25* | -9.09* |
| MS-17×MS-30 | 55.70* | 54.67* | -4.12* | -18.47* | -16.62* | -17.34* | -14.65* | -16.06* | 60.00* | 50.00* |
| MS-74×MS-30 | 42.28* | 41.33* | 17.24* | -5.56* | -15.85* | -16.55* | -8.05* | -14.02* | 36.24* | 30.21* |
| MS-2×MS-15 | 60.56* | 56.16* | 8.67* | 7.04* | -10.43* | -15.49* | -11.52* | -13.43* | 16.07* | 3.64* |
| MS-19×MS-2 | 61.70* | 56.16* | -0.85* | -9.84* | -25.97* | -33.84* | -3.24* | -5.03* | 21.00* | 3.64* |
| MS-31×MS-30 | 50.00* | 45.95* | 53.79* | 27.54* | -27.92* | -33.87* | -13.31* | -15.29* | 36.55* | 33.43* |
| MS-34×MS-30 | 20.00* | 17.57* | 59.17* | 46.92* | 0.82* | -11.87* | -11.63* | -14.79* | 30.26* | 27.25* |
| SS-17×MS-2 | -6.76* | -5.48* | 3.43* | -6.22* | 6.54* | 2.14* | -11.48* | -11.37* | 30.80* | 21.41* |
| SS-17×RNMS-1 | 36.43* | 33.33* | 5.07* | 0.57* | -28.20* | -35.49* | 0.55 | -2.41* | 14.32* | 7.85* |
| MS-28×RNMS-1 | 10.95* | 2.70* | 1.67* | -5.00* | -37.85* | -39.94* | -2.37* | -6.16* | 31.88* | 26.04* |
| MS-2×RNMS-1 | 29.41* | 20.55* | 9.92* | 0.52* | -38.20* | -47.62* | -3.19* | -3.70* | 41.01* | 28.48* |
| MS-39×RNMS-1 | 32.84* | 25.35* | 21.69* | 17.44* | -19.31* | -35.55* | -7.09* | -8.84* | 43.23* | 43.23* |
| Soubhagya×MS-5 | 56.64* | 47.37* | 11.11* | 9.29* | -17.35* | -39.57* | -8.07* | -10.48* | 37.95* | 59.95* |
| Soubhagya×RNMS-1 | 48.20* | 35.53* | 58.60* | 48.63* | -37.62* | -39.57* | -13.06* | -14.45* | 70.79* | 64.03* |
| MS-21×MS-30 | 11.26* | 9.09* | 46.67* | 19.43* | -20.54* | -24.46* | -9.06* | -15.55* | 77.35* | 69.71* |

Table 3: Continue...

| Hybrids | AFW | | TYV | | FL | | FW | | TSS | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Heterosis over | | % Heterosis over | | % Heterosis over | | % Heterosis over | | % Heterosis over | |
| | MP | BP | MP | BP | MP | BP | MP | BP | MP | BP |
| MS-2×MS-30 | 13.78 | 13.77 | 54.14* | 34.92* | -7.26* | -8.31* | 42.36* | 32.18* | 17.53* | -9.11* |
| MS-19×MS-5 | 70.85 | 43.67 | 73.09* | 61.10* | 28.26* | 19.39* | 4.94* | -10.35* | 88.18* | 74.06* |
| MS-17×MS-30 | 2.29 | -15.47 | 64.49* | 43.67* | -7.73* | -22.35* | 19.46* | 18.66* | 34.91* | 13.78* |
| MS-74×MS-30 | 13.20 | -15.76 | 54.32* | 18.67* | -8.88* | -26.73* | 13.44* | 2.35* | 6.60* | -6.67* |
| MS-2×MS-15 | -1.58 | -18.69 | 12.26* | -15.20* | 21.67* | -12.37* | 28.28* | 26.49* | 56.28* | 35.52* |
| MS-19×MS-2 | 19.63 | 3.02 | 40.85* | 6.89* | 5.33* | -7.53* | 45.29* | 28.64* | -44.52* | -50.94* |
| MS-31×MS-30 | -51.50 | -57.22 | -34.30* | -42.41* | -22.09* | -32.38* | -21.13* | -24.51* | 20.87* | 17.78* |
| MS-34×MS-30 | -18.97 | -38.95 | 7.00* | -17.72* | -20.07* | -34.25* | -6.45* | -7.60* | -2.42* | -19.33* |
| SS-17×MS-2 | 11.04 | -8.25 | 43.38* | 11.88* | -10.97* | -24.38* | 20.61* | -8.04* | 31.53* | 7.99* |
| SS-17×RNMS-1 | 33.60 | 9.84 | 48.34* | 16.12* | 38.15* | 19.37* | -2.99* | -8.60* | 31.22* | 14.89* |
| MS-28×RNMS-1 | 10.22 | -10.68 | 46.09* | 22.62* | 5.99* | -9.37* | 10.20* | 9.51* | -13.58* | -19.54* |
| MS-2×RNMS-1 | -20.62 | -36.62 | 8.28* | -19.24* | -10.51* | -30.00* | 7.08* | -3.55* | 80.75* | 39.78* |
| MS-39×RNMS-1 | 54.45 | 44.37 | 61.19* | 66.76* | 11.43* | 0.00 | -18.58* | -27.15* | 10.62* | -5.11* |
| Soubhagya×MS-5 | 9.73 | -30.90 | 63.04* | 10.55* | 5.56* | -6.47* | 65.99* | 41.80* | 49.22* | 17.56* |
| Soubhagya×RNMS-1 | 73.14 | 37.72 | 88.05* | 72.69* | 31.95* | 10.14* | 47.43* | 45.35* | 42.05* | 40.00* |
| MS-21×MS-30 | 2.95 | 2.73 | 17.96* | 15.45* | -19.16* | -29.28* | -18.61* | -22.95* | 30.30* | 17.56* |

VL: Vine length (cm); DAS: days after sowing; SR: Sex ratio (%); DH: Days to first harvest; NFPV - Number of fruits vine$^{-1}$; MP- Mid parent BP-Better parent; AFW: Average fruit weight (g); TYV: Total Fruit yield vine$^{-1}$ (kg); FL: Fruit length (cm); FW: Fruit width (cm); TSS: Total soluble sugars (°brix); MP: Mid parent; BP: Better parent

associated with increase in the vine length. These results are in line with the findings of Ojha et al. (2009) and Sharma et al. (2012) in bottle gourd and Arya and Singh (2014) in cucumber (Table 3).

Earliness is one of the most important trait, which decides how early fruits willreaches the market. Earliness is much desirable character in which we inspect for heterosis in negative direction. Flowering traits like flowers at lower node of the plants indicates earliness of the crop and negativeheterosis for these traits are desirable. Appearance of female flowers at early nodes indicates the earliness of the crop. Hybrids bear's female flowers at its lower nodes compare to parents which is well known as a desirable characters of the hybrids. For sex ratio crosses were reported to be significant in both the direction. The cross SS-17×MS-2 was showed maximum and positive heterosis of 6.54% over mid parent and 2.14% over better parent followed by MS-34×MS-30, showed 0.82% heterosis over mid parent and 22.67% over better parent.Similar results were also found by Singh et al. (2015) and Hanchinmani and Patil (2009) in cucumber. For days to first harvest negative heterosis is desirable so the hybrids has to come to harvest early. Among hybrids the maximum negative magnitude of heterosis over mid parent (-14.65%), better parent (-16.06%) in the cross MS-17×MS-30, followed by in the cross MS-2×MS-30 over mid parent (-14.02%) and 15.55% in MS-2×MS-30 and MS-21×MS-30 over better parent was recorded.

Number of fruits vine$^{-1}$ is an important yield attributing character and also the significant criteria to increase the productivity of crop. Number of fruits per vine exhibited significant magnitude of heterosis in both the direction. Among crosses the maximum magnitude of heterosis over mid parent (77.35%) in the cross MS-21×MS-30, over better parent (69.71%) in the cross MS-21×MS-30 was recorded. These results are also same as that of Singh et al.(2015) in cucumber. Hanchinmani and Patil (2009) was reported positive proportionality of fruit yield vine$^{-1}$ to total yield in cucumber. For average fruit weight magnitude of heterosis over mid parent in both the direction and only one direction over better parent. Maximum and positively significant heterosis of 70.85% over mid parent and 44.37% over better parent was reported in the cross MS-19×MS-5 and MS-39×RNMS-1 respectively.

Yield is one of the important quantitative trait, its components greatly influence in determining the productivity of the crop. Obtaining high yield is one of the prime objectives of all breeding experiments. As phenotypic variance is equals to both genotypic and environmental variances, environment conditions like temperature, relative humidity, rainfall, day length also influences the growth and yield of the plants. For

total yield vine$^{-1}$ among crosses the maximum magnitude of heterosis over midparent (88.05%), better parent (72.69%) in the cross Soubhagya×RNMS-1 was recorded and it was followed by the cross MS-19×MS-5 over mid parent (73.09%) and better parent (61.10%). These results are same as that of El-Hadi et al. (2015) in squash, Airina et al. (2013). For fruit length, hybrids exhibited significant magnitude of heterosis in both the direction. Maximum and positively significant heterosis of 38.15% over mid parent and 19.39% over betterparent was reported in the cross SS-17×RNMS-1 and MS-19×MS-5, respectively similar results were reported by Kalgudi et al. (2021) in intraspecific hybrids of muskmelon and for fruit width Among crosses the maximum magnitude of heterosis (65.99%) over mid parent was recorded in the cross Soubhagya×MS-5, for better parent (45.35%) in the cross Soubhagya×RNMS-1 was estimated, followed by 47.43 % over mid parent in Soubhagya×RNMS-1 and over better parent 41.80% in Soubhagya×MS-5 was reported. Similar results were reported by Arya and Singh (2014) in cucumber, Airina et al. (2013) and Kiran and Singh (2014) in cucumber.Fruit quality parameters like TSS and ascorbic acids are important characters of a fruit to decide its nutritional status. There is a scope for development of variety or hybrid rich in vitamins, minerals and major antioxidants. To combat malnutrition and attaining food security now a day's food production is prominently focusing on nutrition level in the food crops. In the present investigation, TSS of juice of hybrids was reported to be significant in both the direction. The cross (MS-19×MS-5) was showed maximum and positive heterosis of 88.18% over mid parent and 74.06% over better parent, followed by 80.75% in thecross MS-2×RNMS-1 over mid parent and 40.00% in Soubhagya×RNMS-1 over better parent was recorded. The similar results were reported by Nerson (2012) in Muskmelon. However from all these observation the newly developed hybrids were reported to be very significant and superior in their performance over their parents for all traits studied and these hybrids are need to be further evaluation in subsequent segregating population for yield and other quality traits and also have to study for their stability and commercial exploitation.

## 4. Conclusion

Hybrid Soubhagya× RNMS-1 was found to be superior over their parents for most of the traits with the total yield of 8.44 kg vine$^{-1}$. The best performing hybrids are need to be study for their stability and commercial exploitation, screen the newly developed hybrids for the resistance of pest and diseases need to study the keeping quality of hybrids (storability) and to conduct the experiment on hybrid seed production technologies as well as storability of seeds.

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