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Evaluation of Interspecific Hybrids for Yield and Quality Characteristics in Bitter Gourd (*Momordica charantia* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Bitter gourd (*Momordica charantia*) is one of the most nutritional and commercially important vegetable crops of the family cucurbitaceae**.** In the present study, hybrids and parents of bitter gourd were assessed to study the *per se* performance for yield and quality attributes. A wide range of significant variation was observed among all parents and hybrids under study. Among the parents assessed, Preethi and CO-1 was found highly significant with regard to yield attributing characters *viz*., fruit weight, fruit yield per plant, fruit yield ha^{-1} and MCM-1, MCM-2 with regard to number of fruits per plant. The hybrids CO-1 x MCM-2 followed by Preethi x MCM-1 and MCM-1 x Preethi were recorded to be the top performing hybrids for all the quantitative characters like node of first female flower appearance, days taken to first flower appearance, days to 50% flowering, fruit length(cm), fruit girth(cm), fruit weight(g), internodal length(cm), vine length(cm), sex ratio, No of seeds per fruit, No. of fruits per plant, No. of harvest and yield per plant. High ascorbic acid and iron content was recorded in parents MCM-2 and Preethi while it was found maximum in hybrids,

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Preethi x MCM-1, CO-1 x MCM-2 and MCM-1 X Preethi. Hence based on performance of yield and quality, the hybrids, CO-1 x MCM-2, Preethi x MCM-1 and MCM-1 x Preethi were found to be superior and can be exploited for further studies.

Keywords: Evaluation; Momordica charantia; yield and quality characters.

1. INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is one of the commercial cucurbit vegetable of the family cucurbitaceae, grown throughout tropical and subtropical regions of the world and the demand and popularity of this crop is found increasing day by day due to the presence of antidiabetic and nutritive value. The origin is probably India with secondary centre of diversity in china [1]. The genus *Momordica* consists of about 80 known species of annual and perennial climbers, of which *Momordica charantia* is commonly cultivated species with chromosome number of 2n=22. It is locally known by different names as bitter gourd, bitter melon, balsam pear, bitter cucumber, or karela. Being a major contributor of vitamins and minerals especially iron, phosphorous and ascorbic acid, bitter gourd ranks first among all other cucurbits [2]. It is monoecious and highly cross pollinated crop due to its high level of heterozygosity [3]. Bitter gourd is mainly used for making juice and for culinary purpose. The bitterness in bitter gourd is due to the presence of alkaloid momordicine and triterpene glycosides, which is different from cucurbitacin present in other cucurbits.

Among various cultivated cucurbits, bitter gourd has been identified as one of the most potential vegetable crop for export by Agricultural Processed Food Products and Export Development Authority (APEDA) next to onion and okra. Different bitter gourd cultivars contain fruits that vary in shape, ranging from discoid to ovoid or ellipsoid and pointed towards one end [4]. Two prominent varieties of bitter gourd (*Momordica charantia* L.) are generally cultivated in India, namely *M. charantia var. charantia* and *M. charantia var. muricata*. *M. charantia var. charantia* bears large fusiform shaped fruits with numerous tubercules and *M. charantia var. muricata* (Mithipagal) is a small disc shaped fruit bearing numerous tubercules.

Inter specific hybrids are mainly used for transfer of desirable traits from wild species to cultivated species. Due to efforts made by vegetable breeders, improved varieties and hybrids have been developed. Therefore the need of hybrids is of major importance in increasing the production and productivity of the crop, with desirable traits like earliness in flowering, high yield, and quality improvement with resistance to various biotic and abiotic stresses. Hence the present investigation was undertaken with an objective to evaluate interspecific hybrids in bitter gourd for yield and quality traits.

2. MATERIALS AND METHODS

The present experiment was carried out at Horticultural College and Research Institute, Department of Vegetable Science, HC & RI, Tamil Nadu Agricultural University, Coimbatore during the year 2021-2022. The experimental material for this study comprised of 12 treatments (8 Hybrids and 4 Parents) along with check hybrid and the details of the treatment are mentioned below in Table 1. To obtain hybrid combinations, interspecific crossing were made between *Momordica charantia var charantia* (CO-1, Preethi) and *Momordica charantia var muricata* (MCM-1, MCM-2) species in diallel mating design. The experiment was laid out in randomized block design, consisting of two replications. Observations were recorded on economically important parameters *viz*., node of first female flower appearance, days taken to first flower appearance, days taken to 50% flowering, fruit length (cm), fruit girth (cm), fruit weight (g), internodal length (cm), vine length (cm), sex ratio, Number of seeds per fruit, Number of fruits per plant, Number of harvest, yield plant^{-1}, yield hectare^{-1} , fruit fly incidence (%), ascorbic acid and iron content. The biochemical and fruit quality attributes were computed following the methodology suggested by [5] for ascorbic acid and [6] for iron content.

3. RESULTS AND DISCUSSION

The mean values of all treatments in bitter gourd along with standard check hybrid for various yield and yield attributing traits are presented in Table 1. The data for different characters showed significantly appreciable amount of variation among the treatments, indicating the suitability of these treatments for evaluating the hybrids for various characters.

Table 1. Details of treatment

Treatment	Treatment details
T1	MCM-1
T2	MCM-2
T3	CO-1
T4	Preethi
T5	MCM-1 X MCM-2
T6	MCM-2 X MCM-1
T7	MCM-1 X CO-1
T8	CO-1 X MCM-1
T9	MCM-1X Preethi
T10	Preethi X MCM-1
T11	MCM-2 X CO-1
T12	CO-1 X MCM-2
T13	MCM-2 X Preethi
T14	Preethi X MCM-2
T15	CO-1 X Preethi
T16	Preethi X CO-1
T17	Check

In bitter gourd, earliness is considered as an important character and it is judged through first female flower appearance at lower node and minimum time taken for its appearance. Among the parents, MCM-2 flowered on the lowest node of 13.01 followed by MCM-1(15.43) and Co-1(19.42) and among hybrids, CO-1 x MCM-2 (14.13) followed by Preethi x MCM-1(15.02) and MCM-1 x Preethi (15.15) were the earliest. Thakur et al. [7] observed that the first female flower was produced in the lowest node in genotype Punjab-14. These results are also found similar with Sundaram et al. [8] and Priyadharshini et al. [9]

For trait days taken for first flowering, minimum number of days was observed in parents MCM-2 (28.99) followed by MCM-2 (29.76) and CO-1 (30.15) whereas in hybrids, CO-1 x MCM-2 (25.18) followed by Preethi x MCM-1(28.46) and MCM-1 X Preethi (29.11) possessed lesser number of days.

For days taken to 50% flowering, the parent MCM-1 was found to be the earliest with 60.00 days followed by Preethi (60.63) and MCM-2 (61.67) and among hybrids, cross combination CO-1 x MCM-2 (57.00) followed by Preethi x MCM-1(58.76) and MCM-1 x MCM-2 (58.79) showed earliness with regard to 50 % flowering. Similar trend of results was observed for this trait by Adarsh et al. [10].

Fruit length and girth are also important traits to decide the productivity besides market preference. In case of fruit length, longest fruit was recorded in the parent, CO-1 (17.04cm) and then followed by Preethi (16.48 cm) and MCM-2 (8.19 cm) whereas among hybrids, CO-1 x MCM-2 (17.45cm) followed by Preethi x MCM-1(16.87 cm) and MCM-1 x Preethi (16.80 cm) were found to be superior. Mallikarjunaro et al. [11] reported the same range of results for this trait fruit length.

Fruit girth was recorded the highest in parent Preethi (12.30 cm) followed by CO-1 (11.97 cm) and MCM-2 (10.25 cm) while in hybrids, Preethi x MCM-1 exhibited relatively maximum girth of 13.00 cm which is followed by CO-1 x MCM-2 (12.48 cm) and Preethi X MCM-2 (12.40). Sundaram et al. [8] reported that fruit girth ranged from 8.83cm (MDU 1 x vadaipatti local) to 13.89 cm (Bikaner 1 x Bikaner 3) in case of bitter gourd hybrids. However similar range was also reported for this trait by Rani et al. [12].

Number of fruits along with fruit weight directly determines the bitter gourd yield as reported by Dey et al. 2005. In this experiment among parents, maximum number of fruits per plant was recorded in MCM-2 (15.74) followed by MCM-1 (15.18) and Preethi (11.18). The cross combination namely, CO-1 x MCM-2 was found to produce higher number of fruits of 20.12 which is followed by Preethi x MCM-1(18.71) and MCM-1 x Preethi (17.58). Singh et al. [3] reported maximum number of fruits in parents *viz.*, HABG-31 (15.40) and HABG-34 (15.12) and similar results were also recorded for this trait by Thakur et al. [7].

The highest average fruit weight among the parents was observed in Preethi (84.25 g) followed by CO-1(79.21g) and MCM-2 (29.52 g)

while the hybrid CO-1 x MCM-2 (84.29 g) followed by Preethi x MCM-1(82.67 g) and MCM-1 x Preethi (79.64 g) recorded the maximum weight among other hybrids. Alhariri et al. [13], Rani et al. [12] and Kumari et al. [14] reported the same trend of results for this trait.

A narrow sex ratio of male to female is preferred in cucurbits. Lower the sex ratio more will be the number of female flowers. In the present study, parent CO-1 recorded the lowest sex ratio of 16.41 and it is followed by MCM-2 (18.32) and Preethi (18.33) while among hybrids, lowest sex ratio was observed in CO-1 x MCM-2 (14.85) followed by Preethi x MCM-1 (15.51) and MCM-1 x Preethi (18.27). The similar findings were also recorded by Thangamani et al. [15] and Islam et al. [16] for this trait.

For the trait total number of seeds per fruit, the parent Preethi (16.52) followed by CO-1(16.44) and MCM-2 (9.49) recorded the maximum number of seeds. Among hybrids, CO-1 x MCM-2 (21.61) produced comparatively more number of seeds which is followed by Preethi x MCM-1 (20.46) and MCM-1 x Preethi (19.35). The findings of this result were found similar with Zehara et al. [17].

Vine length is an important factor in bitter gourd that eventually influences the yield. In the present study, vine length among parental lines was found high in Preethi (403.29 cm) followed by CO-1 (398.38 cm) and MCM-1 (232.81 cm). In case of hybrids, CO-1 x MCM-2 (405.83 cm) followed by Preethi x MCM-1(398.26 cm) and MCM-1 x Preethi (325.24 cm) exhibited desired vine length. Similar range of results was recorded with findings of Kumari et al. [14] and Islam et al. [16] for vine length.

Lower internodal length is desirable for higher productivity in cucurbits. In case of parents, shortest internodal length was observed in MCM-2 which recorded 5.15 cm among the parents followed by MCM-1(5.42 cm) and Preethi (6.68 cm). Among hybrids, crosses CO-1 x MCM-2 (5.24 cm) followed by Preethi x MCM-1(5.31 cm) and MCM-1 x Preethi (5.58 cm) registered lowest internodal values. The result obtained was found similar with findings of Rani et al. [12], Kumari et al. [14] and Yadav et al. [18] in bitter gourd.

Fruit yield per plant and fruit yield per hectare are the economically important trait for a variety or hybrid. Among all parents, the highest fruit yield per plant was recorded in Preethi (0.94 kg) followed by CO-1 (0.85 kg) and MCM-2 (0.46) and among hybrids, cross combination CO-1 x MCM-2 (1.70 kg) followed by Preethi x MCM-1(1.54 kg) and MCM-1 x Preethi (1.40 kg) has recorded significantly higher fruit yield. Similar range of findings for this trait was recorded by Zehara et al. [17], Thakur et al. [7] and Yadav et al. [18].

In case of fruit yield per hectare, Preethi recorded highest yield of 7.05 t/ha among the parents and it is followed by CO-1 (6.41 t/ha), MCM-2 (3.45 t/ha). The cross combination, CO-1 x MCM-2 (12.75 t/ha) followed by Preethi x MCM-1(11.55 t/ha) and MCM-1 x Preethi (10.50 t/ha) among hybrids registered highest total fruit yield. Similar range of results for fruit yield per hectare was reported by Singh et al. [3].

For trait number of harvests, the parent MCM-2 (4.12) followed by Preethi (4.04) and CO-1 (4.01) recorded the superior values whereas among hybrids, maximum number of harvests was observed in CO-1 x MCM-2 (7.02) followed by Preethi x MCM-1(6.03) and MCM-1 x Preethi (6.01). Reshmika et al. [19] reported similar findings for this trait. In recent report, Sunny et al. [20] recorded that the maximum number of harvests was observed in the hybrid KAU-MCGy-101 x Preethi (12.00) followed by Preethi x KAU-MCGy-101, KAU-MCGy-101 x Priyanka (11.33).

Lower infestation of fruit flies might increase the fruit yield. Minimum infestation of fruit fly was noticed in the parent MCM-1 (5.76 %) followed by MCM-2 (8.33%) and Preethi (9.09%). Among the hybrids, CO-1 x MCM-2 (7.23%) followed by Preethi x MCM-1 (9.18%) and MCM-1 x Preethi (9.39%) were infested least.

Among the biochemical traits, ascorbic acid and iron content are nutritionally important characters. The parents, MCM-2 (105.28 mg/100 g) followed by Preethi (99.04 mg/100 g) and CO-1 (98.51 mg/100 g) and the hybrids Preethi x MCM-1(105.89 mg/100 g) followed by CO-1 x MCM-2 (98.67 mg/100 g) and MCM-1 x Preethi (91.52 mg/100 g) recorded significant values of ascorbic acid content., High level of iron content among parents was observed in case of MCM-2 (3.12 mg/10 0g), CO-1 (2.73 mg/100g) and MCM-1 (2.65 mg/100 g) while in case of hybrids, Preethi x MCM-1 (2.49 mg/100 g) recorded highest iron content which is followed by CO-1 x MCM-2 (2.35 mg/100 g) and MCM-1 x Preethi (1.76 mg/100 g). These results were in similarity with Kumari et al. [14] for ascorbic acid content and Thangamani et al. [15] for ascorbic acid and iron content.

Table 2. Mean performance of parents and hybrids for yield and its quality traits

S.No	Treatment details	Vine length (cm)	Inter nodal length (cm)	Days to first flowering	Days to 50% flowering	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Node of first female flower appearance	Sex ratio(M/F)
1	MCM-1	232.81	5.42	28.99	60.00	5.5	8.08	21.18	15.43	20.04
2	MCM-2	224.76	5.15	29.76	61.67	8.19	10.25	29.52	13.01	18.32
3	CO-1	398.38	6.92	30.15	61.69	17.04	11.97	79.21	19.42	16.41
4	Preethi	403.29	6.68	30.96	60.63	16.48	12.3	84.25	19.59	18.33
5	Check	320.15	6.57	31.00	61.76	15.3	11.73	57.35	20.18	20.76
6	MCM-1 X MCM-2	300.28	5.98	29.21	58.79	12.67	10.38	49.98	15.48	19.35
7	MCM-2 X MCM-1	276.87	6.02	28.93	59.33	14.81	9.99	50.72	15.22	18.77
8	MCM-1 X CO-1	302.35	5.66	30.31	59.37	13.11	10.01	52.48	19.84	20.02
9	CO-1 X MCM-1	301.64	6.12	28.29	59.06	14.4	12.34	54.00	21.17	20.29
10	MCM-1X Preethi	325.24	5.58	29.11	59.00	16.8	12.11	79.64	15.15	18.27
11	Preethi X MCM-1	398.26	5.31	28.46	58.76	16.87	13.00	82.67	15.02	15.51
12	MCM-2 X CO-1	298.23	5.49	30.45	59.65	15.08	12.39	61.84	19.62	20.14
13	CO-1 X MCM-2	405.83	5.24	25.18	57.00	17.45	12.48	84.29	14.13	14.85
14	MCM-2 X Preethi	300.37	6.52	29.24	59.21	14.49	11.21	56.09	21.04	19.68
15	Preethi X MCM-2	301.02	6.13	30.75	59.23	13.46	12.40	60.31	21.12	19.03
16	CO-1 X Preethi	305.39	6.05	31.58	57.57	16.78	12.08	76.62	16.35	19.38
17	Preethi X CO-1	300.78	6.11	32.03	60.00	15.91	12.42	79.33	16.09	18.62
18	**Mean**	**317.39**	**5.94**	**29.67**	**59.57**	**14.37**	**11.39**	**62.32**	**17.52**	**18.69**
19	**C.V. (%)**	**1.41**	**2.38**	**2.76**	**1.94**	**1.73**	**2.35**	**1.97**	**3.78**	**2.56**
20	**S.Ed**	**4.61**	**0.14**	**0.82**	**1.16**	**0.25**	**0.27**	**1.23**	**0.65**	**0.47**
21	**C.D. (0.5%)**	**9.77**	**0.30**	**1.73**	**2.46**	**0.53**	**0.57**	**2.61**	**1.38**	**1.00**

Table 3. Mean performance of parents and hybrids for biochemical traits

S.No	Treatment details	No. of fruits plant^{-1}	No of seeds fruit^{-1}	Yield plant^{-1} (kg)	Yield ha^{-1} (t/ha)	No. of harvest	Fruit fly incidence (%)	Ascorbic acid (mg/100g)	Iron content (mg/100g)	Total duration (days)
1	MCM-1	15.18	9.28	0.32	2.41	3.99	5.76	94.13	2.65	103.08
2	MCM-2	15.74	9.49	0.46	3.45	4.12	8.33	105.28	3.12	105.1
3	CO-1	10.79	16.44	0.85	6.41	4.01	10.01	98.51	2.19	114.03
4	Preethi	11.18	16.52	0.94	7.05	4.04	9.09	99.04	2.73	116.48
5	Check	14.21	18.21	0.81	6.08	4.24	15.72	77.64	1.03	104.69
6	MCM-1 X MCM-2	15.92	10.06	0.80	6.00	4.11	11.08	87.1	1.52	100.02
7	MCM-2 X MCM-1	15.18	9.87	0.77	5.78	3.82	10.55	90.02	1.64	98.04
8	MCM-1 X CO-1	14.17	17.00	0.74	5.55	5.10	12.5	79.09	1.29	100.09
9	CO-1 X MCM-1	11.32	17.9	0.61	4.58	5.15	11.2	79.45	1.4	99.21
10	MCM-1X Preethi	17.58	19.35	1.40	10.50	6.01	9.39	91.52	1.76	110.02
11	Preethi X MCM-1	18.71	20.46	1.54	11.55	6.03	9.18	105.89	2.49	113.23
12	MCM-2 X CO-1	15.92	13.58	0.98	7.35	4.02	11.76	80.33	1.27	100.05
13	CO-1 X MCM-2	20.12	21.61	1.7	12.75	7.02	7.23	98.67	2.35	119.01
14	MCM-2 X Preethi	12.39	15.96	0.69	5.18	3.59	11.11	74.02	1.36	98.53
15	Preethi X MCM-2	12.75	16.02	0.77	5.78	4.04	12.31	80.34	1.57	99.04
16	CO-1 X Preethi	13.86	18.11	1.06	7.95	5.98	10.62	83.38	1.31	104.01
17	Preethi X CO-1	14.09	18.41	1.12	8.40	5.28	9.43	82.01	1.16	106.06
18	**Mean**	**14.65**	**15.78**	**0.92**	**6.87**	**4.74**	**10.31**	**88.61**	**1.81**	**105.33**
19	**C.V. (%)**	**2.1**	**2.98**	**3.32**	**2.48**	**2.38**	**2.47**	**2.39**	**3.20**	**2.28**
20	**S.Ed**	**0.31**	**0.46**	**0.03**	**0.17**	**0.11**	**0.25**	**2.12**	**0.06**	**2.39**
21	**C.D. (0.5%)**	**0.65**	**0.99**	**0.06**	**0.36**	**0.24**	**0.54**	**4.48**	**0.12**	**5.07**

4. CONCLUSION

Overall findings of present study concluded that the observations recorded for various quantitative and qualitative traits in bitter gourd parents and hybrids, showed significant results for all the traits. Among all four parents, MCM-2 was found to be best for trait related to earliness in flowering. However Preethi and CO-1 were superior for most of the yield traits. As per the present investigation, the hybrids CO-1 x MCM-2 followed by Preethi x MCM-1 and MCM-1 x Preethi were proved to perform best with regard to all the parametric characters involved in the study. According to biochemical point of view, the best parents for highest ascorbic acid and iron content were found to be MCM-2 followed by Preethi. The hybrids, Preethi x MCM-1 followed by CO-1 x MCM-2 were found to be the rich source iron and ascorbic acid. Hence the results of present study suggests that hybrids namely, CO-1 x MCM-2, Preethi x MCM-1 and MCM-1 x Preethi obtained from crossing of parents could be exploited commercially for inheritance of economic characters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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