Characterization of Intraspecific F_1 Hybrids of *Momordica charantia* L. Based on Morphology, Cytology and Palynology

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Summary Intraspecific hybrids of *Momordica charantia* produced by both direct and reciprocal crosses were characterized for plant morphology, cytology, foliar epidermal and palynological features in comparison with cultivated and wild varieties. The parents and F_1 hybrids were evaluated for a total of 56 morphological characters including 17 qualitative and 39 quantitative traits. Both the parents and the F_1 hybrids showed significant variations in most of the quantitative characters. The hybrids were intermediate in characters like color of the ovary, color and shape of fruit, number of seeds and in the distribution of trichomes on the stem and leaves, although they exhibited most of the parental characters. Unweighted Pair Group Method with Arithmetic Mean (UPGMA) dendrograms and Principal Coordinate Analysis (PCoA) scatter plots revealed the grouping of cultivated varieties together with the F_1 hybrids. The most important loading traits as per the Principal Component Analysis (PCA) were pedicel length, fruit weight, fruit length, fruit diameter, fruit color, and the number of seeds. Cytological, foliar epidermal and palynological features are used to discuss the interrelationship of the 2 varieties of *M. charantia*.

Key words Hybridization, Crossability, Principal component analysis, Principal coordinate analysis, *Momordica charantia* L.

Momordica charantia L., commonly known as bitter gourd (bitter melon), is an important vegetable crop of the family Cucurbitaceae and consists of 2 varieties, *M.charantia* var. *charantia*, which produces large fusiform fruits, and *M.charantia* var. *muricata*, a wild variety with small and round fruits (Chakravarthy 1990). The fruits of *M.charantia* are widely consumed and have wide commercial distribution in Asia (Ram *et al.* 2006) in addition to its wide application in the field of medicine. Both the wild and cultivated varieties exhibit wide variations with regard to their morphological features, especially in pomological characters.

The inter specific and intra specific hybridizations have an immense role in tracing genome relationships. Studies on inter-specific hybridization in *Momordica* were carried out to establish phylogenetic relationships (Pal *et al.* 1983 and Vahab 1989). Bharathi *et al.* (2011) reported crossability studies among dioecious species such as *M.dioca*, *M.cochinchinensis*, and *M.subtangulata* subsp.*renigera*. However, studies on intraspecific hybridization involving crossability studies in *M.charantia* are lacking, although variation exists in certain desirable qualities related to crop improvement among the varieties. Hence, the present investigation suggests crossability studies between wild and cultivated varieties of *M.charantia* to assess the interrelationship of the taxa. Data from morphological, foliar epidermal, cytological, and palynological characters were analyzed to understand the transfer of parental genetic attributes to the F_1 generation and to establish the interrelationship of the taxa.

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Materials and methods

The cultivated variety, *M.charantia* var. *charantia*, procured from Kerala Agricultural University and the wild variety, *M.charantia* var. *muricata*, collected from the Kollam district, were the materials used for the present investigation.

Crossability

Crossing was made in the plants grown in the Department of Botany, University of Kerala. Both direct and reciprocal crosses were carried out by the hand emasculation method using the wild and cultivated varieties of *M.charantia* as parents. The percentage of crossability was calculated by the following formula;

$$\% \text{ of crossability} = \frac{\text{Number of fruits obtained}}{\text{Number of flowers pollinated}} \times 100$$

The F_1 hybrids raised from the crosses involving cultivated varieties as female and as male were designated as hybrid-1 (h1) and hybrid-2 (h2) respectively.

Morphology

Observations on various morphological traits were scored for 5 plants randomly selected from each population. A total of 56 characters, 17 qualitative and 39 quantitative morphological traits, of the wild and cultivated varieties and their F_1 hybrids, were evaluated using the descriptors proposed by John and Antony (2011). Patterns of morphological similarity/difference were analyzed by one-way ANOVA using the SPSS software package and multivariate statistical methods including principal component analysis (PCA). A phenogram was constructed using the Unweighted Pair Group Method with Arithmetic Mean (UPGMA) using the NTSYS software package. For foliar epidermal studies, epidermal peelings taken from the mature leaves were stained with 1% aqueous safranin, mounted in glycerin and photographs were taken using a compound microscope.

Cytology

Young staminate buds were fixed between 11.00–11.30 p.m. in Carnoy's fluid and were subjected to smear preparation using 2% aceto carmine for meiotic analysis. Photomicrographs were taken by using Leica Model DM 2000 (BF/PH/DF).

Palynology

The acetolysis method proposed by Erdtman (1952) and modified by Nair (1970) was employed for the palynological investigation. Pollen morphological characters were analyzed, namely the shape of the pollen grain, exine ornamentation and the length of the colpi of the F_1 hybrids and parents. Pollen sterility was also estimated.

Results

Crossability Study

Both the direct and the reciprocal crosses—*M.charantia* var.*charantia* ($\varnothing$) $\times$ *M.charantia* var.*muricata* (σ^7) and *M.charantia* var.*muricata* ($\varnothing$) $\times$ *M.charantia* var.*charantia* (σ^7)—were found to be successful. Crossability percentages of the respective crosses are shown in Table 1.

Morphological study

Comparisons of the qualitative and quantitative morphological characters of the wild and cultivated taxa and their respective F_1 hybrids are given in Tables 2 and 3 respectively (Figs. 1a–e). It

Table 1. Crossability between *M. charantia* var. *charantia* and var. *muricata*.

Combination of female and male parents	Number of flowers pollinated	Number of fruits formed	Crossability percentage
<i>M. charantia</i> var. <i>charantia</i> (♀) × var. <i>muricata</i> (♂)	15	15	100%
<i>M. charantia</i> var. <i>muricata</i> (♀) × var. <i>charantia</i> (♂)	18	16	88.89%

Table 2. Qualitative characters of the *M. charantia* var. *charantia*, var. *muricata* and their F₁ hybrids.

No.	Characters	<i>M. charantia</i> var. <i>charantia</i>	<i>M. charantia</i> var. <i>muricata</i>	Hybrid-1	Hybrid-2
1	Stem color	Pale green	Dark green	Pale green	Pale green
2	Pubescent nature (stem and leaves)	Highly pubescent	Slightly pubescent	Medium	Medium
3	Tendrils type	Simple, forked	Simple	Simple, forked	Simple
4	Color of leaves	Spinach green	Spinach green 0960	Spinach green	Spinach green
5	Venation	Multicostate reticulate	Multicostate reticulate	Multicostate reticulate	Multicostate reticulate
6	Leaf tip	Acute	Acute	Acute, obtuse	Acute, obtuse
7	Leaf lobing	Lobed & shallowly sub lobed	Lobed & shallowly sub lobed	Lobed & shallowly sub lobed	Lobed & deeply sub lobed
8	Calyx color	Cyprus green 59/3	Cyprus green 59/3	Cyprus green 59/3	Cyprus green 59/3
9	Color of bracts	Dark green	Dark green	Dark green	Dark green
10	Surface of sepals	Hairy	Hairy	Hairy	Hairy
11	Color of petals	Lemon yellow	Lemon yellow	Lemon yellow	Lemon yellow
12	Stigma	3 lobbed	3 lobbed	3 lobbed	3 lobbed
13	Anther color	Yellow	Yellow	Yellow	Yellow
14	Color of the ovary	Agathiagreen 60/1	Cyprus green 59/1	Cyprus green 59/2	Cyprus green 59
15	Mature fruit color	Pea green 61/2	Lettuce green 86	Cyprus green 59/1	Paris green 58/1
16	Ovary surface	Tubercled	Tubercled	Tubercled	Tubercled
17	Fruit shape	Elliptical	Disc	Oblong	Oblong

Table 3. One-way ANOVA of quantitative morphological characters of the *M. charantia* var. *charantia*, var. *muricata* and their F₁ hybrids (Mean±Standard error).

Population	Internode length (cm)	Petiole length (cm)	Lamina length (cm)	Lamina width (cm)	Lamina area (cm)	Vine length (cm)
Cultivated	7.08±0.29 ^a	3.79±0.11 ^a	6.78±0.25 ^a	8.69±0.15 ^a	44.63±3.88 ^a	16.04±1.66 ^a
Wild	5.66±0.46 ^b	2.28±0.19 ^c	5.13±0.25 ^c	5.98±0.25 ^b	22.88±1.26 ^b	11.6±0.88 ^b
Hybrid-1	6.49±0.45 ^{ab}	3.65±0.14 ^a	5.93±0.05 ^b	8.28±0.08 ^a	43.5±1.69 ^a	12.2±0.77 ^{ab}
Hybrid-2	7.14±0.51 ^a	2.8±0.08 ^b	4.74±0.41 ^c	6.41±0.45 ^b	39.13±2.99 ^a	15.85±1.54 ^a
<i>F</i> value	2.5 ^{NS}	26.64***	11.18***	24.28***	14.21***	3.39*

Population	♀ Flower pedicel length (cm)	♀ Flower bract length (cm)	♀ Flower bract width (cm)	No of sepals in ♀ flower	♀ Flower sepal length (cm)	♀ Flower sepal width (cm)
Cultivated	5.4±0.45 ^a	0.8±0.06 ^a	1.34±0.03 ^a	5±0 ^d	0.46±0.08 ^a	0.14±0.02 ^a
Wild	3.43±0.27 ^b	0.35±0.02 ^b	0.48±0.04 ^c	5±0 ^c	0.24±0.02 ^b	0.11±0.01 ^a
Hybrid-1	4.6±0.31 ^a	0.6±0.08 ^a	1.41±0.01 ^a	5±0 ^a	0.33±0.04 ^b	0.14±0.02 ^a
Hybrid-2	2.83±0.09 ^b	0.68±0.01 ^a	0.93±0.08 ^b	5±0 ^b	0.25±0.02 ^b	1.0±0.02 ^a
<i>F</i> value	14.07***	6.86***	34.32***	—	5.06**	1.70 ^{NS}

Table 3. continued.

Population	No: of petals in ♀ Flower	♀ flower petal length (cm)	♀ flower petal width (cm)	Ovary length (cm)	Style length (cm)	Distance b/w bract & node in ♀ flower (cm)
Cultivated	5±0 ^d	1.31±0.06 ^a	1.03±0.07 ^a	1.03±0.09 ^a	0.58±0.03 ^a	0.66±0.11 ^b
Wild	5±0 ^c	0.9±0.03 ^b	0.65±0.04 ^b	0.33±0.03 ^c	0.36±0.02 ^c	0.49±0.06 ^b
Hybrid-1	5±0 ^a	0.136±0.07 ^a	1.05±0.09 ^a	0.53±0.2 ^b	0.46±0.03 ^b	1.2±0.16 ^a
Hybrid-2	5±0 ^b	0.95±0.05 ^b	0.61±0.04 ^b	0.58±0.03 ^b	0.4±0.04 ^{bc}	0.84±0.13 ^b
F value	—	18.22***	14.03***	37.60***	11.23***	6.24**

Population	Distance b/w bract & calyx in ♀ flower (cm)	Distance b/w bract & node in ♂ flower (cm)	Distance b/w bract & calyx in ♂ flower (cm)	♂ flower pedicel length (cm)	♂ flower bract length (cm)	♂ flower bract width (cm)
Cultivated	4.16±0.244 ^a	2.59±0.17 ^a	3.74±0.12 ^a	7.01±0.30 ^a	1.19±0.07 ^a	1.21±0.09 ^b
Wild	3.89±0.28 ^a	2.63±0.35 ^a	2.7±0.33 ^b	4.36±0.21 ^b	0.29±0.03 ^c	0.5±0.04 ^c
Hybrid-1	3.6±0.26 ^a	2.96±0.33 ^a	3.36±0.12 ^a	6.68±0.08 ^a	0.94±0.05 ^b	1.71±0.01 ^a
Hybrid-2	2.33±0.21 ^b	1.43±0.28 ^b	1.78±0.18 ^c	3.6±0.14 ^c	0.44±0.14 ^c	0.56±0.05 ^c
F value	10.56***	5.29**	17.21***	69.15**	25.90***	51.69***

Population	No of sepals in ♂ flower	♂ flower sepal length (cm)	♂ flower sepal width (cm)	No :of petals in ♂ flower	♂ flower petal length (cm)	♂ flower petal width (cm)
Cultivated	5±0 ^d	0.91±0.06 ^a	0.39±0.03 ^a	5±0 ^d	1.88±0.07 ^a	1.25±0.04 ^b
Wild	5±0 ^c	0.6±0.07 ^b	0.2±0.03 ^b	5±0 ^c	1.2±0.06 ^c	0.71±0.06 ^c
Hybrid-1	5±0 ^a	0.83±0.03 ^a	0.36±0.02 ^a	5±0 ^a	1.58±0.02 ^b	1.31±0.03 ^a
Hybrid-2	5±0 ^b	0.59±0.03 ^b	0.33±0.02 ^a	5±0 ^b	1.55±0.04 ^b	1.14±0.04 ^b
F value	—	10.75***	12.67***	—	28.95***	37.51***

Population	Stamen length (cm)	Fruit pedicel length (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (gm)	Number of seed/fruit
Cultivated	0.54±0.03 ^{ab}	7.25±0.73 ^a	15.31±0.63 ^a	4.96±0.17 ^a	60.48±1.58 ^a	24.38±2.41 ^a
Wild	0.34±0.02 ^c	4.51±0.36 ^b	3.81±0.25 ^d	1.94±0.12 ^c	4.04±0.38 ^d	2.88±0.44 ^c
Hybrid-1	0.58±0.02 ^a	4.13±0.07 ^b	8.29±0.25 ^c	4.16±0.22 ^b	41.18±1.07 ^c	18.75±1.13 ^b
Hybrid-2	0.5±0.00 ^b	4.21±0.09 ^b	10.06±0.65 ^b	4.43±0.23 ^b	50.99±3.61 ^b	21±1.85 ^{ab}
F value	33.79***	13.33***	95.796***	60.10***	145.44***	33.92**

Population	Seed length (cm)	Seed diameter (cm)	Seed weight (gm)
Cultivated	1.33±0.05 ^{ab}	0.83±0.02 ^{ab}	0.20±0.06 ^a
Wild	0.89±0.02 ^c	0.7±0.02 ^{bc}	0.15±0.09 ^b
Hybrid-1	1.21±0.05 ^b	0.85±0.04 ^a	0.13±0.01 ^b
Hybrid-2	1.44±0.08 ^a	0.76±0.02 ^c	0.18±0.08 ^a
F value	18.65***	7.57***	11.61***

NS non-significant

*, ** and *** significant at 5 %, 1% and .01% probability levels, respectively.

was observed that most of the qualitative characters of the parents and hybrids were similar, but significant variation was observed in the quantitative characters. The F₁ hybrids exhibited greater proportions (74.00,72.00%) of parental characters in hybrid-1 and hybrid-2 than the intermediate characters. The hybrids were intermediate in characters like color of the ovary, color and shape of fruit, number of seeds and in the distribution of trichomes on the stem and leaves (Figs. 1b, c, f–i). However, extreme variations were found in traits like width of bract in male flowers and in the distance between bract and node and bract and calyx in the male and female flowers of the hybrids.

Fig. 1.

Morphometric analysis

The PCA analysis revealed that the first principal component accounted for 69.89% of the phenotypic variance and the second one accounted for 19.61%. It was evident (Table 4) that the most important loading traits as per the PCA were pedicel length, fruit weight, fruit length, fruit diameter, fruit color, and the number of seeds.

The UPGMA dendrogram suggested 2 major principal clusters at a Euclidean distance of 1.9 (Fig. 2). The first principal cluster was that of the wild taxa whereas the second principal cluster had 2 sub-clusters. The first sub-cluster consisted of the cultivated variety at a Euclidean distance of 1.1 and the second sub-cluster grouped F₁ hybrids together at a distance of 0.9. A similar grouping was observed in the principal coordinate analysis (PCoA) scatter plot (Fig. 3). The hybrids were seen together in 1 axis, adjacent to the cultivated variety. The third axis constituted the wild variety with distinct varietal coordination.

Table 4. Highly loaded characters in PCA.

Characters	Axis 1	Axis 2
Fruit pedicel length	0.045	0.709
Fruit weight	0.564	-0.023
Number of seeds	0.424	-0.028
Fruit length	0.233	0.148
Fruit color	0.215	-0.224
Fruit diameter	0.154	0.010
Eigen values	0.808	0.227
Percentage	69.89	19.61
Cumulative percentage	69.89	89.504

Fig. 2.

Fig. 3.

Cytology

Meiosis was regular in the PMCs of the wild and cultivated taxa with the haploid number as $n=11$ (Figs. 4a, b). Meiocytes of the F_1 hybrids also showed $n=11$ bivalents at metaphase (Figs. 4c, d). Chromosomal abnormalities were absent in the F_1 hybrids. Anaphase separations of the hybrids were normal. Pollen fertility was found to be 83.00% and 87.00% respectively for the h1 and h2 hybrids.

Foliar epidermal and trichome analysis

The epidermal characters of both the parents and F_1 hybrids revealed that the leaves were amphistomatic and stomata were of anomocytic type. There were no significant variations in the epidermal features of the cultivated and wild taxa and their F_1 hybrids. They all possessed multicellular and uniseriate trichomes. Significant variations were observed in the length of the trichomes of the stem and leaves (Figs. 1f-i). However, the intermediate nature of trichomes was found in the stem. Cystoliths of 2 and 3 groups were seen in the cultivated and wild varieties and in their F_1 hy-

Fig. 4.

brids. Details of the epidermal characters are given in Table 5.

Palynological study

Palynological studies revealed that the cultivated and wild varieties and their F_1 hybrids possessed 3-zonocolporate pollen grains (Figs. 4e–h) with reticulate exine ornamentation (Figs. 4i–l). Colpi were long reaching up to the apocolpial region. Pollen characters of the parents and the F_1 hybrids are given in Table 6.

Discussion

Crossability

The crossability study revealed that both crosses were compatible. The percentage of crossability was higher (100.00%) when the cultivated variety was used as the female parent. Some difference in the percentage of crossability was reported in the reciprocal crosses between the wild and cultivated species of *Vigna* by Satija and Vikal (1993). A high percentage of crossability and fruit set observed in the study indicates that the 2 varieties are genetically compatible and are closely related. Variations in the percentage of crossability may be due to the changes in the geno-

Table 5. Epidermal features of *M. charantia* var. *charantia* and var. *muricata* and their F₁ hybrids.

Plant	Length of the trichomes	Type of the stomata	Stomata		Guard cell		Subsidiary cell		Stomatal complexes	
			Length	Width	Length	Width	Length	Width	Length	Width
Cultivated	1102	Anomocytic	19.37	13.07	17.60	5.42	30.07	13.56	42.95	43.85
Wild	693	Anomocytic	15.35	17.96	14.62	6.38	25.10	15.52	43.04	42.73
Hybrid-1	734	Anomocytic	20.88	12.25	14.93	3.75	28.87	17.42	34.45	45
Hybrid-2	712	Anomocytic	18.33	15.59	17.11	5.15	30.82	18.73	49.35	51.5

Table 6. Palynological characters of *M. charantia* var. *charantia* and var. *muricata* and their F₁ hybrids.

Plant	P	E	Exine thickness	Length of colpi	P/E×100	Shape
Cultivated	75.13	69.49	2.68	50.50	108	Prolate spheroid
Wild	79.13	72.55	3.02	62.42	109	Prolate spheroid
Hybrid-1	84.44	69.44	3.618	59.21	121.6	Sub prolate
Hybrid-2	78.96	78.48	3.69	70.39	101	Prolate spheroid

types of the parents involved in the crosses. The close relationship between the wild and cultivated varieties of *Cucumis* was suggested based on crossability (Imazu and Fujishita 1959, Kho *et al.* 1980, Beevy 1994).

Morphological study

The analysis of qualitative morphological data revealed the close relationship of the hybrids with that of their parents. However, the parents and the F₁ hybrids showed significant variations in most of the quantitative characters. It was also observed that the hybrids possessed both parental and intermediate characters. The expression of parental characters in the hybrids suggests the dominant nature of those characters. Intermediate characters observed in the hybrids indicate that it may be controlled by more than 2 genes. According to Gottlieb (1984) and Hilu (1983), high proportions of parental characters expressed in the first generation hybrids tend to support the view that many morphological traits are controlled by 1 or 2 genes. Characters under multigenic control are predicted to be intermediate in first generation hybrids (Riesenberg and Ellstrand 1993). The intermediate nature of F₁ hybrids has been reported by Roy *et al.* (1966) and Satija and Vikal (1993) in crosses between species of *Momordica* and *Vigna* respectively. Sain *et al.* (2003) opined that the intermediate character expression of F₁ hybrids and the resemblance to either of the parents were attributable to additive gene action and dominance respectively in the genus *Citrullus*. The presence of extreme characters in the hybrids observed during the investigation may be due to the fixation of recessive genes present in heterozygous form in the parents. Extreme character expression was reported in hybrids of *Helianthus* (Schwarzbach *et al.* 2001).

Morphometric analysis

The significance of morphometric analysis in ascertaining the interrelationship of cultivated and wild taxa is well established. In the present investigation, PCA provided significant differentiations among the cultivated and wild variety and their F₁ hybrids, while considering the qualitative and quantitative characters (Table 4). Since the first axis of the PCA showed a highly dominating variation (69.89%), the most loaded traits in the first axis, including fruit weight, fruit length, fruit diameter, number of seeds and fruit color, were highly significant in differentiating the wild and cultivated varieties and their respective hybrids. Thus, it can be concluded that the intraspecific variations in *M. charantia* may be mainly due to the changes that occurred in fruit morphology as a

result of artificial selection. Selection based on the desirable phenotypic traits, such as fruit morphology, is the most common phenomenon during plant domestication. Kendrick *et al.* (2004) suggested that the domestication of *M.charantia* is mainly based on fruit morphology.

Cluster analysis based on morphology revealed that the wild variety was distinct from the cultivated variety (Fig. 2). The clustering of 2 hybrids (hybrid-1, 2) along with the cluster of *M.charantia* var. *charantia* suggests that the cultivated variety dominates over the wild variety. Close relationships of the hybrids to one of its parents was observed in the genus *Passiflora* (Santos *et al.* 2011). The charting of the hybrids in distinct groups and in close association with the cultivated variety was evident in the PCoA scatter plot of the morphological traits, whereas the wild variety formed a separate group. The occurrence of the hybrids together in the same axis, adjacent to the cultivated variety revealed that most of the characters shown by the F₁ hybrids are transferred from the cultivated variety. The most loaded PCA trait may be the key factor for this bifurcation. The third axis, with the wild variety having distinct varietal coordination, points out its unique entity.

Cytological study

PMCs with 11 bivalents at metaphase of meiosis in both the parents and F₁ hybrids indicated the close relationship between the cultivated and wild variety. Lack of any chromosomal abnormality in the hybrids suggests the genetic harmony between the parental genomes. Patel *et al.* (1997) also reported the same in the hybrids of some legumes in India. Anaphase separation was normal in both the F₁ hybrids, resulting in the formation of regular tetrads.

Foliar epidermal & trichome analysis

The foliar epidermal study (Table 6) revealed that the wild and cultivated varieties and their F₁ hybrids shared most of epidermal features. However, they showed significant variations with regard to the length of the trichomes. The hybridity of trichomes in the hybrids was evident from the intermediate nature of trichomes in the stem. The parents and hybrids shared uniformity in the distribution of cystolith. The hybridity of stomata and other epidermal characters were reported in the interspecific cross between *Cucumis pubescens* and *Cucumis melo* (Beevy 1994).

Palynological study

The uniformity of the pollen grains in the aperture form and in the ornamentation pattern (Table 7) revealed the close relationships of the taxa. Pollen grains with large size (121.6 µm) in the F₁ hybrid of var.*charantia* (♀)×var.*muricata* (♂) indicate the vigor of the hybrid. Subprolate pollen grains observed in h2 suggest that the trait is controlled by more than 2 genes. Beevy and Kuriachan (2007) reported F₁ hybrids with an increase in the size of the pollen grains in an intraspecific cross in *Cucumis*.

Conclusion

Intraspecific crossability studies in *Momordica charantia* L. and the characterization of F₁ hybrids were carried out in the present investigation. Crossability and qualitative morphological studies revealed the close relationship between *M.charantia* var. *charantia* and *M.charantia* var. *muricata*. The one-way ANOVA exhibited significant variations in the quantitative morphological characters of the wild and cultivated variety and their F₁ hybrids. Morphometric analysis by PCA revealed that fruit morphology is the main character that distinguished the wild and cultivated varieties and their hybrids. The close relationship of the hybrids with the cultivated variety was evidenced from the UPGMA cluster analysis. The PCoA scatter plot revealed that grouping of cultivated variety together with the F₁ hybrids may be due to the greater expression of genes inherited from the cultivated parent. Cytological, foliar epidermal and palynological analysis also established

the interrelationship of the 2 varieties of *M.charantia*.

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