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Assessment of Bitter Gourd Hybrids for Charantin and Other Vital Qualitative Traits

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ABSTRACT

A field experiment was conducted in the Vegetable Experimental Field, College of Horticulture in Venkataramannagudem, Andhra Pradesh, during the summer and *kharif* seasons of 2022 in order to identify parents and cross combinations which have performed best for major quality attributes. To generate 21 F_1 crosses, seven parents were maintained in a parental block (Summer 2022) and crossed in a half diallel mating pattern. For quality parameters like TSS, vitamin-C and iron the crosses viz., Preethi× Special Boldar, Kashi Mayuri× IC -68314, IC-68314 × Special Boldar were identified as promising ones. Charantin is important quality attribute, which was reported to be anti-diabetic in nature. Kashi Mayuri × IC-68314, IC-433630 × IC-68314 and IC-68314 × Special Boldar among the hybrids while IC-68314, IC-469512 and IC-433630 among the parents were found to be best performers for the charantin content in fruits. The identified promising crosses were further evaluated under multilocational trails and various seasons to know the potentiality before commercial release.

Keywords Charantin, Iron, TSS, Vitamin-C, *Momordica charantia* L.

INTRODUCTION

Momordica charantia L., often referred to as the bitter melon, is a tropical vegetable with the chromosomal number 2n=2x=22 and is a member of the Cucurbitaceae family. In English, *Momordica charantia* is frequently referred to as bitter melon, balsam pear, or bitter cucumber. In India, it is known by the common names Karela (Hindi) and Karvella (Sanskrit). It is a common vegetable in Indian cuisine and is eaten both fresh as juice and cooked as a vegetable. It is said to have originated in tropical Asia, notably in certain parts of eastern India. It is one of those medicines that has been used for centuries for both culinary and medicinal uses, but is most famous for being beneficial to the people with diabetes.

In India, the area under bitter gourd cultivation is 1.01 lakh ha with an annual production of 12 lakh tonnes and productivity of 12.16 MT/ha. Chhattis-

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garh, Telangana, Andhra Pradesh, Orissa, Madhya Pradesh, Uttar Pradesh and Bihar are the major bitter gourd producing states in the country (NHB database 2021-22).

It is a nutritious vegetable with an abundance of vitamins, minerals, phytonutrients, antioxidants, polyphenols, and other nutrients; nevertheless, the presence of phytonutrients like charantin, vicin, and L-peptide also makes it a traditional remedy for treating a variety of ailments (Patel *et al* 2010). Due to the presence of several compounds that serve as antioxidants, antimicrobials, antidiabetic, antiviral, antihepatotoxic, and antiulcer agents, it is an old medicinal vegetable crop. Fruits and other plant components have a bitter flavor because momordicine alkaloid is present. The presence of the hypoglycaemic compound "charantin" in bitter gourd fruits gives them unique antidiabetic characteristics and aids in lowering blood sugar levels. According to Goo *et al.* (2016), the cucurbitane-type tri-terpenoid peptide known as charantin is very efficient at regulating blood sugar with regard to insulin resistance. As a result, in the field of medicine, where research is being done to identify new, efficient plant sources for treating diabetes, bitter gourd is regarded as a vegetable insulin. A lower level of research has been done on the bitter gourd's high charantin concentration, though. The parents and their hybrid progeny were evaluated in this paper to determine which of them performed better for certain key bitter gourd quality parameters.

MATERIALS AND METHODS

The research project titled "Assessment of bitter gourd hybrids for charantin and other vital qualitative traits." Took place in the *summer* and *kharif* of 2022 at the College of Horticulture, Dr YSR Horticultural University Venkataramannagudem, West Godavari District of Andhra Pradesh. At an elevation of 34 m (112 ft) above mean sea level, the site has been identified as being in Agro-climatic zone 10, Humid, East Coast Plain and Hills (Krishna-Godavari zone), with an average rainfall of 900 mm. Geographically speaking, the test location was located at 16°63' 120" N latitude and 81°27' 568" E longitude. The area has humid, hot summers and pleasant winters. In half-diallel form, seven paternal lines were crossed in all possible ways, excluding reciprocals, generating 21 single crosses. Table 1 lists the seven parents that were part of the study. From each replication, five plants that were selected at random were chosen, and data on quality parameters such as TSS, vitamin-C, iron and charantin contents was recorded.

Table 1. List of parental lines and checks with their source of supply.

Sl. No.	Parents / Commercial checks	Source
1	Preeti	KAU, Thrissur, Kerala
2	Kashi Mayuri	IIVR, Varanasi, Uttar Pradesh
3	IC-44418	NBPGR, Thrissur, Kerala
4	IC-68314	NBPGR, Thrissur, Kerala
5	IC-433630	NBPGR, Thrissur, Kerala
6	IC-469512	NBPGR, Thrissur, Kerala
7	Special Boldar	NBPGR, Thrissur, Kerala
8	Pragati	East West seeds, Andhra Pradesh
9	Monarch	Hyveg seeds, Haryana

Biochemical analysis

Total soluble solids (°Brix)

At room temperature, total soluble solids in fruit juice were calculated using an Abbe's refractometer (0–32^{0}Brix). With the use of a temperature correlation chart, the data were adjusted at 100°C and shown as a percentage of the juice's TSS.

Vitamin-C content (mg 100g^{-1})

Three percent metaphosphoric acid was used to thoroughly crush ten grams of bitter gourd sample, and three percent metaphosphoric acid was also used to make up 100 ml of the mixture. The mixture was thoroughly blended before being run through filter paper. As long as the bright pink color retained for at least 15 seconds, 10 ml of the aliquot was titrated against the reference dye solution (2, 6-dichlorophenol indophenol dye). Using the suggested formula, the estimated vitamin-C content was reported as mg 100 g^{-1}.

$$\text{Vitamin-C content (mg } 100\text{g}^{-1}) = \frac{\text{Titre value} \times \text{dye factor} \times \text{volume made up}}{\text{Aliquot taken} \times \text{weight of the sample}}$$

Iron content (mg 100g^{-1})

Two grams of the sample were placed in a flask along with two ml of a 9:3 di-acid combination of nitric acid and perchloric acid. The flask was then left undisturbed overnight, and the following day it was heated to between 115 and 118°C for digestion in order to collect a watery translucent aliquot. After being digested, the sample was filtered and its final volume increased to 50 ml by diluting it with double-distilled water. The Versand approach was then used to estimate iron (Jackson 1973).

Charantin content (mg 100g^{-1})

A dried sample weighing 0.5g was refluxed in 20 ml of 80% methanol for two hours. The process was repeated three times and the supernatant should be collected in a 50 ml volumetric flask. 80% methanol was used to create a volume up to 50 ml.

Reagents

(i.) 5% vanillin acetic acid
(ii.) Perchloric acid
(iii.) Acetic acid

Procedure

A test tube containing around 0.1 ml of the filtered solution was placed in the oven to evaporate at 60^{0}C. Following the completion of the evaporation process, 0.8 ml of perchloric acid is added after 0.2 ml of 5% vanillin acetic acid. The test tube should be shaken by the vortex. Following the vortex, the test tube was left in the water bath at 60°C for 15 minutes. After 15 minutes, the test tube was cooled to ambient temperature, placed into a vortex, and then 4 ml of acetic acid was added. At 573 nm, absorbance was last measured against a blank. A standard curve made using a charantin 1 standard with a concentration of 1 mg/10 ml was used to determine the concentration of charantin.

Table 2. General ANOVA for quality traits in bitter gourd.

Sl. No.	Character	Mean sum of squares		
		Replication	Treatment	Error
	df	2	29	54
1.	TSS	0.011	2.410**	0.027
2	Vitamin-C (mg 100 g^{-1})	2.167	142.179**	4.380
3	Iron (mg 100 g^{-1})	0.001	0.765**	0.000
4	Charantin (mg 100 g^{-1})	0.000	0.059**	0.000

** 1% level of significance, * 5% level of significance.

RESULTS AND DISCUSSION

Analysis of variance

The analysis of variance of means was carried out to test the significance of differences among the treatments. The data pertaining to the analysis of variance are furnished in Table 2. It was found that variance among the treatments was significant for four characters studied.

***Per se* performance of parents and crosses**

The data pertaining to the mean performance of parents, crosses and standard checks are presented in Table 3 respectively.

Quality attributes

TSS (°Brix): The TSS of different genotypes varied from 3.04 to 6.98 with a general varied from 3.04 to 6.98 with a general mean 5.93 (Table 3 and Fig. 1). Among the parents it varied from 3.04 (IC-469512) to 6.87 (Kashi Mayuri) and ranged from 3.53 (IC-68314 x IC-469512) to 6.98° Brix (IC-433630 x IC-469812) among the hybrids. However, the mean TSS for checks Pragathi and Monarch was recorded as 5.64 and 4.97. IC-433630 x IC-469512, Kashi Mayuri x IC-68314, IC-68314 x Special Boldar were exhibited highest TSS among the hybrids studied.

Vitamin-C content (mg 100g^{-1}): The vitamin-C content of different genotypes varied from 76.89 to 100.89 with a general mean 90.01 (Table 1 and Fig. 2). Among the parents it varied from 87.25 (Preethi) to 98.56 mg (IC-469512) and ranged from 76.89 (Preethi x IC-44418) to 100.89 mg (Preethi x Special Boldar) among the hybrids. All the hybrids have shown highest vitamin-C content than the standard checks Pragathi and Monarch (76.89 and 89.54 mg). Highest

Table 3. Mean performance of parents and hybrids for TSS, vitamin-C content, iron content, charantin content in bitter gourd.

Treatments	TSS (°Brix)	Vitamin-C content (mg 100 g^{-1})	Iron content (mg 100 g^{-1})	Charantin content (mg 100 g^{-1})
Parents				
Preethi	6.52	87.25	0.24	0.49
Kashi Mayuri	6.87	91.45	1.26	0.53
IC-44418	6.43	88.89	0.67	0.64
IC-433630	5.98	92.56	1.11	0.68
IC-68314	6.46	90.54	0.56	0.81
IC-469512	3.04	98.56	0.66	0.73
Special Boldar	4.97	93.34	1.67	0.50
Parents mean	**5.75**	**91.80**	**0.88**	**0.63**
Crosses				
Preethi x Kashi Mayuri	6.17	93.24	1.06	0.38
Preethi x IC-44418	5.93	95.34	1.54	0.43
Preethi x IC-433630	6.19	90.37	1.62	0.70
Preethi x IC-68314	6.02	76.89	1.32	0.75
Preethi x IC-469512	5.19	86.98	1.06	0.63
Preethi x Special Boldar	5.82	100.89	1.95	0.55
Kashi Mayuri x IC-44418	6.52	90.26	0.46	0.58
Kashi Mayuri x IC-433630	6.20	91.87	0.98	0.73
Kashi Mayuri x IC-68314	6.89	82.27	0.87	0.91
Kashi Mayuri x IC-469512	6.42	94.16	1.67	0.66
Kashi Mayuri x Special Boldar	5.92	99.87	0.69	0.57
IC-44418 x IC-433630	5.93	99.53	0.57	0.67
IC-44418 x IC-68314	5.89	97.67	0.77	0.84
IC-44418 x IC-469512	6.34	90.67	1.28	0.71
IC-44418 x Special Boldar	5.12	98.56	0.79	0.57
IC-433630 x IC-68314	5.64	78.34	0.37	0.89
IC-433630 x IC-469512	6.98	85.45	1.19	0.79
IC-433630 x Special Boldar	5.82	78.45	1.34	0.61
IC-68314 x IC-469512	3.53	86.45	1.24	0.60
IC-68314 x Special Boldar	6.84	96.89	1.77	0.82
IC-469512 x Special Boldar	5.89	95.34	0.67	0.44
Crosses mean	**6.00**	**90.07**	**1.19**	**0.66**
Checks				
Pragathi	5.64	76.89	0.89	0.59
Monarch	4.97	89.54	0.65	0.62
Grand Mean	**5.9396**	**90.0168**	**1.0871**	**0.6419**
SEm ±	0.0965	1.2084	0.0165	0.0091
CD at 5%	0.2732	3.4209	0.0467	0.0259
CD at 1%	0.3635	4.5515	0.0621	0.0344
Range	**3.04 to 6.98**	**76.89 to 100.89**	**0.24 to 1.95**	**0.38 to 0.91**6

vitamin-C content was recorded by the genotypes Preethi x Special Boldar and Kashi Mayuri x Special Boldar. The results are in agreement with the findings of Talekar *et al*. (2013), Lalwani *et al.* (2014), Amrita *et al.* (2020) and Bajarang *et al.* (2020).

Iron content (mg 100g^{-1}): The Iron content of genotypes varied from 0.24 to 1.95 mg with a general mean of 1.08 (Table 1 and Fig. 3). The iron content of parents varied from 0.24 (Preethi) to 1.67 mg (Special Boldar). The hybrids were in the range of 0.37 (IC-433630 x IC-68314) to 1.95 mg (Preethi x Special Boldar) as compared to the standard checks Pragathi and Monarch (0.89 and 0.65 mg). Among the 21 hybrids, IC-68314 x Special Boldar and Preethi x Special Boldar were recorded the highest TSS and

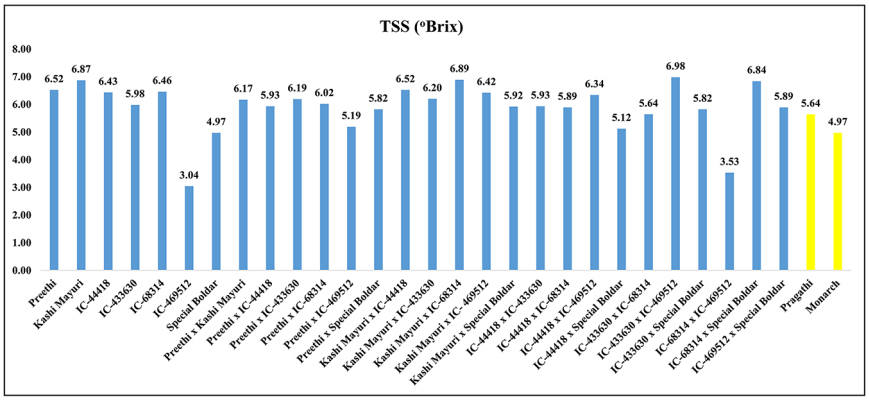

Fig. 1. Variation in TSS (°Brix) among the treatments under study.

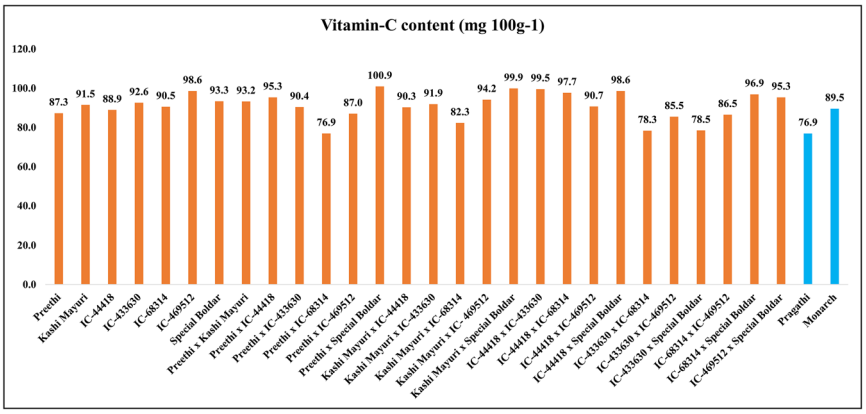

Fig. 2. Variation in vitamin-C content (mg $100g^{-1}$) among the treatments under study.

iron content. Similar results were reported earlier by Jadhav *et al*. (2009), Talukdar *et al.* (2010) and Bajrang *et al.* (2020).

Charantin content (mg $100g^{-1}$): The charantin content varied from 0.38 to 0.91 mg with a general mean of 0.64 mg (Table 1 and Fig. 4). The parents exhibited

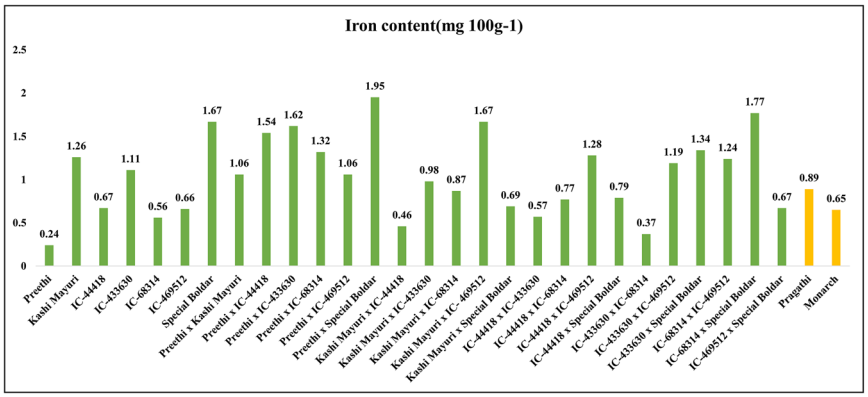

Fig. 3. Variation in iron content (mg $100g^{-1}$) among the treatments under study.

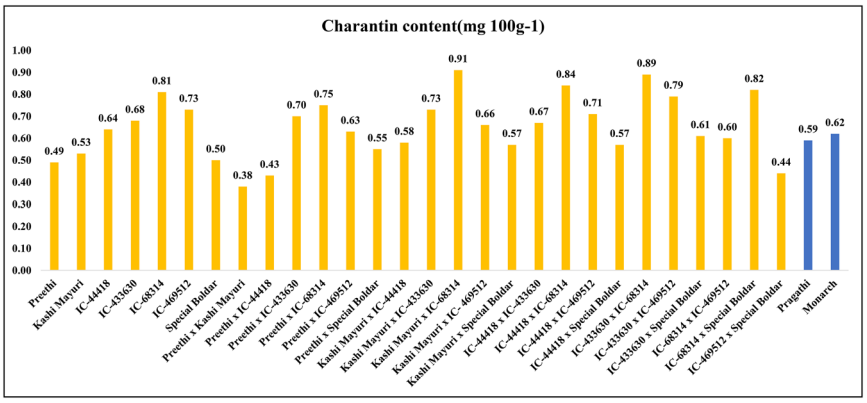

Fig. 4. Variation in charantin content (mg $100g^{-1}$) among the treatments under study.

a range of 0.50 (Special Boldar) to 0.81 (IC-68314). The charantin content of hybrids were in the range of 0.38 (Preethi x Kashi Mayuri) to 0.91 mg (Kashi Mayuri x IC-68314). The crosses like Kashi Mayuri x IC-68314 (0.91), IC-433630 x IC-68314 (0.89), IC-68314 x Special Boldar (0.82), IC-433630 x IC-469512 (0.79), Preethi x IC-68314 (0.75), Kashi Mayuri x IC-433630 (0.73) and IC-44418 x IC-469512 (0.71) among the hybrids whereas IC-68314 (0.81), IC-469512 (0.73) and IC-433630 (0.68) among the hybrids have recorded highest charantin content than the standard checks Pragathi and Monarch (0.59 and 0.62 mg). Similar results were identified by Patel *et al.* (2010), Shanmugapriya and Poornima (2014) and Goo *et al.* (2016).

CONCLUSION

Any crop must have high-quality traits because they add nutritional value. In the current study, there was a substantial difference between genotypes in terms of quality attributes including TSS, vitamin C, iron, and charantin. The crosses viz., IC-433630 x IC-469512, Kashi Mayuri x IC-68314, IC-68314 x Special Boldar, Preethi x Special Boldar, Kashi Mayuri x Special Boldar were found as best performers for TSS, vitamin-C and Iron contents. Charantin is a chemical compound that may be used to treat diabetic patients and is reportedly highly effective in regulating blood glucose levels. It works similarly to insulin in this regard. Highest charantin was recorded in the genotypes namely Kashi Mayuri x IC-68314, IC-433630 x IC-68314, IC-68314 x Special Boldar and IC-68314.

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REFERENCES

Amrita K, Sangeeta S, Randhir K, Chandan K, Singh VK, Haque M (2020) Estimation of heterosis for yield and quality traits in bitter gourd (*Momordica charantia* L.). *Int J Curr Microbiol Appli Sci* 9(02) : 1614-1623. DOI: https://doi.org/10.20546/ijcmas.2020.902.185.

Bajrang K, Anand KS, Prachi P, Diksha M, Pal AK, Binod KS (2020) Line × Tester analysis for estimation of heterosis in bitter gourd (*Momordica charantia* L.). *J Pharmacogn Phytochem* 9 (2) : 486-490.

Goo KS, Ashari S, Basuki N, Sugiharto AN (2016) The bitter gourd (*Momordica charantia* L.) Morphological aspects, charantin and vitamin C contents. *J Agric Vet Sci* 9(10) : 2319-2372. DOI: 10.9790/2380-0910017681.

Jackson ML (1973) Soil chemical analysis. Prentice – Hall of India Private Limited, New Delhi, pp 498.

Jadhav KA, Garad BV, Dhumal SS, Kshirsagar DB, Patil BT, Shinde KG (2009) Heterosis in bitter gourd (*Momordica charantia* L.). *Agric Sci Dig* 29 (1) : 7-11.

Lalwani HH, Vaddoria MA, Jyoti K, Mehta DR, Jog KJ (2014) Heterosis and in breeding depression studies in bitter gourd for yield and related characters. *Prog Res* 9 (Special) : 914-917.

NHB Data Base (2021-22) Published by National Horticulture Board. Department of Agriculture and Co-operation Government of India.

Patel S, Patel T, Parmar K, Bhatt Y, Patel Y, Patel NM (2010) Isolation, characterization and antimicrobial activity of

charantin from *Momordica charantia* Linn. Fruit. *Inter J Drug Devt & Res* 2(3) : 629-634.

Shanmugapriya R, Poornima S (2014) Detection of charantin in the leaves and fruits of *Momordica tuberosa* (Cogn) Roxb and *Momordica dioica* (Roxb Ex Wild) by analytical HPTLC. *Inter J Sci Res Pu* 4(6) : 1-8. DOI: https://api.semanticscholar.org/CorpusID:17147884.

Talekar NS, Vaddoria MA, Kulkarani GU (2013) Heterosis studies for quantitative traits in bitter gourd (*Momordica charantia* L.). *Prog Re*s 8 : 650-653.

Talukdar MB, Rahman MM, Islam MK, Rahman KAMM, Hossen MA (2010) Estimate of heterosis in bitter gourd. *J Bangla Agric Univ* 4(2) : 73-79. URI: http://archive.saulibrary.edu.bd:8080/xmlui/handle/123456789/2184