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Mean Performance of Parents and Hybrids for Fruit Yield and quality characters in Snake gourd [*Trichosanthes anguina* (L.)]

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ABSTRACT: This research was conducted in 2022-23 at the Vegetable Research Block, situated within the esteemed College of Horticulture at Dr. Y.S.R. Horticultural University in Venkataramannagudem, Andhra Pradesh, India. The principal objective of this study was the assessment of growth and yield-related traits in both parent and hybrid snake gourd varieties. Among the six parent varieties scrutinized in this investigation, specifically IC 347377, Kaumudi, and PKM-1, the recorded yields were 12.06 kg, 9.79 kg, and 9.42 kg per vine, respectively. In contrast, the hybrid varieties, namely Manusree × CO-2, PKM-1 × CO-2, CO-2 × IC 212513, and PKM-1 × IC 347377, exhibited remarkable yields, producing 20.25 kg, 18.84 kg, 18.02 kg, and 15.95 kg per vine, respectively, in the cultivation of snake gourd. These findings underscore the promising potential of the parent varieties for inclusion in future breeding programs, offering avenues for the enhancement of snake gourd characteristics. Concurrently, the high-yielding hybrid varieties, distinguished by their impressive productivity, are strongly recommended for broad adoption within the commercial cultivation of snake gourd. This research outcome contributes substantial insights to the domain of snake gourd cultivation, providing valuable guidance to growers and breeders for the purpose of informed decision-making aimed at elevating crop productivity.

Keywords: Snake gourd, Mean performance, High yielding, Breeding programmes, Yield, Quality.

INTRODUCTION

Snake gourd [*Trichosanthes anguina* (L.) 2n=2x=22], is an annual, day-neutral, herbaceous climbing vegetable crop that falls under the Cucurbitaceae family. Its origin can be traced back to the Indo-Malayan region. This vegetable holds considerable importance in the human diet, particularly in India, its tender, green, or immature fruits are commonly used for cooking, including preparations such as chutneys and curries.

Snake gourd is not just valued for its culinary versatility; it also contributes to the nutritional quality of diets. It contains significant levels of protein (0.5%), fat (0.3%), minerals (0.5%), fiber (0.5%), and carbohydrates (3.3%) (Gopalan and Balasubrmanian 1982). What's more, it possesses medicinal importance due to its rich content of flavonoids, carotenoids, phenolic acids, and various essential minerals like potassium (121.6mg/100 g), phosphorus (135mg/100 g), sodium, magnesium, and zinc (Ojiako and Igwe 2008). Additionally, snake gourd exhibits pharmacological and therapeutic properties, including being anti-diabetic, hepatoprotective, cytotoxic, and anti-inflammatory, making it a valuable asset in traditional medical practices like Ayurveda and Siddha (Warrier *et al.*, 1993).

The monoecious nature of snake gourd, characterized by the presence of both male and female flowers on the same plant, bestows a distinct economic advantage in the production of F_1 hybrid seeds. This inherent trait eliminates the need for emasculation, a labor-intensive and costly process in conventional breeding methods. Furthermore, this botanical characteristic results in a higher yield of hybrid seeds per cross, thereby enhancing the overall cost-effectiveness of hybrid seed production.

Additionally, the practice of cultivating snake gourd with wider plant spacing, a common practice, further contributes to the efficiency of hybrid seed production. This is particularly relevant in the context of commercial vegetable cultivation, where the hybrid seed rate per hectare remains relatively low, making it a cost-efficient proposition.

Consequently, snake gourd stands as a highly promising candidate for harnessing hybrid vigor on a commercial scale, with the potential to significantly augment both production and productivity in the agricultural sector. Genotypes that exhibit robust performance can be leveraged in two key ways: they can be released as distinct and valuable varieties in their own right, or they can be integrated into ongoing heterosis breeding programs to continue advancing the crop's genetic potential. This dual approach not only serves to meet the demands of modern agriculture but also offers a sustainable path toward crop improvement and food security.

MATERIAL AND METHODS

The experimental study involved the utilization of six parental lines: PKM-1, Manusree, Kaumudi, IC 347377, CO-2 and IC 212513 (Fig. 1). These parental lines were subjected to a diallel crossing scheme during the Kharif season of 2022, with reciprocals excluded. Subsequently, a total of 15 F_1 hybrids, along with the six parent lines and two checks, were selected for evaluation during the summer of 2023. The evaluation was conducted using a randomized block design, incorporating two replications with plant spacing set at 2 × 1.5 meters.

Throughout the evaluation period, observations were meticulously recorded from five randomly chosen plants within each plot. The observed traits encompassed various growth and yield-related attributes *viz*., fruit length (cm),fruit girth (cm), average fruit weight (g), number of fruits per vine, fruit yield per vine (kg), number of seeds per fruit, vitamin C content (mg 100 g^{-1}), potassium content (mg 100 g^{-1}), total soluble solids (°B), and fiber content (g 100g-1) to see the mean performance of parents and hybrids.

RESULTS AND DISCUSSION

In the rigorous analysis of mean squares, it is noteworthy that significant differences attributed to the treatments were observed across all the characters examined, as meticulously detailed in Table-1. Subsequently, the treatment means were subjected to further stratification, classifying them into three distinct categories: parents, hybrids, and parents versus hybrids. It is pertinent to emphasize that the parental varieties exhibited statistically significant differences across all the characters studied, underscoring their unique contributions to the observed traits. Similarly, the hybrid combinations displayed significant variations in all the characteristics under scrutiny. However, when making comparisons between parents and hybrids, significant differences emerged for all the characters, with the notable exception being the number of fruits per vine.

Delving into the per se performance, as elucidated in Table-2, it becomes evident that for fruit length and fruit girth, the parental varieties exhibited a range spanning from 55.20 (Manusree) to 27.20 (CO-2) and from 16.15 (CO-2) to 13.05 (IC 212513), respectively. In stark contrast, the crossbreed combinations displayed a broader spectrum, encompassing values ranging from 67.25 (Manusree × Kaumudi) to 25.70 (PKM-1 × IC 212513) for fruit length, and from 21.80 (PKM-1 × Manusree) to 8.50 (Kaumudi × IC 347377) for fruit girth. These findings closely align with the empirical results documented by Ahsan *et al.* (2011); Ashwini (2014); Deepa Devi *et al.* (2017) in the context of snake gourd, as well as Abusaleha and Dutta (1994); Shaha and Kale (2003) in relation to ridge gourd.

Regarding average fruit weight, number of fruits per vine, and fruit yield per vine, the parental varieties demonstrated a range spanning from 431.00 (IC 347377) to 225.50 (CO-2), 28.40 (CO-2) to 20.62 (IC 212513), and 12.06 (IC 347377) to 6.45 (CO-2), respectively. In stark contrast, the cross combinations exhibited a broader spectrum, encompassing values ranging from 581.66 (Manusree × Kaumudi) to 186.33 (Kaumudi × IC 212513) for average fruit weight, 44.28 (Manusree × CO-2) to 14.94 (IC 347377 ×IC 212513) for the number of fruits per vine, and 20.25 (Manusree × CO-2) to 5.62 (Manusree × IC 347377) for fruit yield per vine. These results closely parallel those of Ashwini (2014); Deepa Devi *et al*. (2017) in snake gourd, as well as Abusaleha and Dutta (1994); Rao *et al.* (2000); Shaha and Kale (2003) in ridge gourd.

For the trait of the number of seeds per fruit, the parental varieties ranged from 75.25 (Manusree) to 29.25 (PKM-1), while the cross combinations exhibited values spanning from 72.00 (Manusree × Kaumudi) to 20.00 (Kaumudi × IC 212513). These outcomes closely align with the findings reported by Deepa Devi *et al*. (2017) in the context of snake gourd, and Abusaleha and Dutta (1994); Shaha and Kale (2003) in ridge gourd.

Turning attention to the character of vitamin C content, potassium content, total soluble solids, and fiber content, the parental varieties displayed a range spanning from 4.65 (Kaumudi) to 3.58 (IC 347377), 275.50 (CO-2) to 155.00 (IC 347377), 4.39 (PKM-1) to 2.93 (IC 347377), and 0.60 (Manusree) to 0.25 (CO-2), respectively. The cross combinations, on the other hand, exhibited a broader spectrum, encompassing values ranging from 5.50 (Manusree × CO-2) to 3.14 (Kaumudi × IC 347377) for vitamin C content, 275.00 (PKM-1 × IC347377) to 160.00 (Manusree × IC212513) for potassium content, 5.80 (Manusree × CO-2) to 3.10 (Manusree × IC 212513) for total soluble solids, and 0.85 (Manusree × Kaumudi) to 0.30 (Kaumudi × IC 212513) for fiber content. These findings are in alignment with the research outcomes documented by Karmakar *et al.* (2013); Chittora *et al.* (2018) in the context of ridge gourd.

For visual reference, figures depicting the promising hybrid varieties are presented in Fig. 2-5, respectively.

Fig. 1. Parents used in the experiment.

Table 1: Analysis of variance for growth, yield, yield attributing and quality characters in 6×6 half diallel of snake gourd.

Source	Df	Fruit length	Fruit girth	Average fruit weight	No. of fruits per vine	Fruit yield per vine	Number of seeds per fruit	Vitamin C content	Potassium content	TSS	Fibre content
Mean sum of squares											
Treatments	20	221.76***	23.92***	24378.98***	116.97***	50.01***	607.89***	0.69***	3052.22***	1.20***	0.05***
Parents	5	187.77***	2.42***	11886.40***	21.15***	6.80***	787.83***	0.30***	5585.06***	0.63***	0.03***
Hybrids	14	247.50***	32.14***	30574.26***	159.55***	68.76***	550.11***	0.89***	23611.67***	1.19***	0.05***
Parents vs hybrids	1	31.31***	16.39***	107.88***	0.0003	3.61***	517.10***	0.04***	55.73***	4.37***	0.11***
Error	20	0.022	0.00236	2.44	0.01132	0.00495	0.06068	0.00008	0.304	0.00016	0.00004

* and ** Significance at 5% and 1% level respectively.

Table 2: Per se performance of parents and hybrids for fruit yield and quality attributing traits in 6×6 half diallel of snake gourd.

Sr. No.	Pedigree/cross	Fruit length	Fruit girth	Average fruit weight	No. of fruits per vine	Fruit yield per vine	No. of seeds per fruit	Vitamin C content	Potassium content	TSS	Fibre content
1.	PKM-1 × Manu sree	33.50	21.80	410.00	19.93	8.20	32.50	4.76	170.00	4.90	0.40
2.	PKM-1 × Kaumudi	58.75	15.22	452.80	23.14	11.26	30.25	4.25	178.00	4.20	0.50
3.	PKM-1 x IC 347377	42.33	21.08	427.53	36.45	15.95	38.00	5.20	275.00	5.65	0.60
4.	PKM-1 × CO-2	46.40	17.22	547.50	35.47	18.84	45.50	4.64	224.00	4.70	0.75
5.	PKM-1× IC 212513	25.70	14.73	210.00	22.05	4.80	25.00	3.78	172.00	3.92	0.40
6.	Manu sree × Kaumudi	67.25	14.75	581.66	21.06	12.48	72.00	3.93	205.50	4.07	0.85
7.	Manu sree × IC 347377	43.00	12.00	236.75	23.76	5.62	22.00	3.75	186.00	4.43	0.50
8.	Manu sree × CO-2	58.00	13.27	440.56	44.28	20.25	65.60	5.50	225.50	5.80	0.65
9.	Manu sree × IC 212513	52.00	17.20	327.20	22.46	7.34	48.45	3.40	160.00	3.10	0.35
10.	Kaumudi × IC 347377	40.63	8.50	210.67	18.41	3.87	21.00	3.14	162.70	3.75	0.40
11.	Kaumudi × CO-2	42.75	11.55	350.75	16.75	5.95	51.00	4.20	195.00	4.21	0.55
12.	Kaumudi × IC 212513	37.50	10.75	186.33	18.24	3.39	20.00	3.82	170.50	3.36	0.30
13.	IC 347377 × CO-2	37.60	18.67	357.00	16.04	5.72	28.68	3.55	182.00	4.30	0.60
14.	IC 347377 × IC 212513	58.80	15.75	379.50	14.94	5.69	56.44	3.72	198.00	3.96	0.65
15.	CO-2 × IC 212513	47.30	21.22	497.75	35.36	18.02	30.15	4.40	256.35	5.20	0.70
Hybrid mean		**46.10**	**15.58**	**374.40**	**24.55**	**9.82**	**39.10**	**4.13**	**197.37**	**4.37**	**0.54**
16.	PKM-1	40.75	13.77	376.50	25.04	9.42	29.25	4.50	256.50	4.39	0.50
17.	Manu sree	55.20	14.65	424.40	21.36	9.06	75.25	4.18	188.50	3.70	0.60
18.	Kaumudi	50.80	14.10	408.60	23.96	9.79	68.50	4.65	158.50	4.20	0.40
19.	IC 347377	45.79	13.47	431.00	27.99	12.06	32.00	3.58	155.00	2.93	0.35
20.	CO-2	27.20	16.15	225.50	28.40	6.45	35.75	3.95	275.50	3.25	0.25
21.	IC 212513	45.40	13.05	401.68	20.62	8.28	40.48	4.34	165.50	3.47	0.50
Parent mean		**44.19**	**14.19**	**377.94**	**24.56**	**9.17**	**46.87**	**4.20**	**199.92**	**3.65**	**0.43**
22.	Nagin (check)	90.00	12.25	455.00	26.50	12.05	65.00	4.02	195.00	4.50	0.45
23.	Chachinda -10(check)	101.00	14.05	473.85	23.24	11.01	72.00	3.86	186.00	3.93	0.50
Check mean		**95.50**	**13.15**	**464.42**	**24.87**	**11.53**	**68.50**	**3.94**	**190.50**	**4.21**	**0.47**
Grand mean		**49.89**	**15.01**	**383.15**	**24.58**	**9.80**	**43.68**	**4.13**	**197.43**	**4.17**	**0.51**
S.E. ± m		0.1760	0.0335	1.0844	0.0720	0.0478	0.1840	0.0060	0.3730	0.0085	0.0045
C.D. @ 5%		0.5161	0.0983	3.1805	0.2111	0.1402	0.5396	0.0175	1.0939	0.0250	0.0133
C.D. @ 1%		0.7015	0.1336	4.3229	0.2869	0.1905	0.7334	0.0237	1.4868	0.0340	0.0180

* and ** Significance at 5% and 1% level respectively.

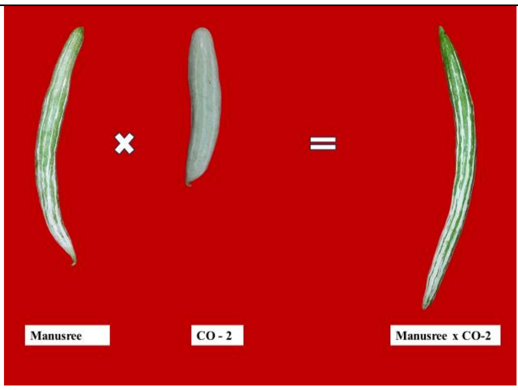

Fig. 2. Promising hybrid in the investigation.

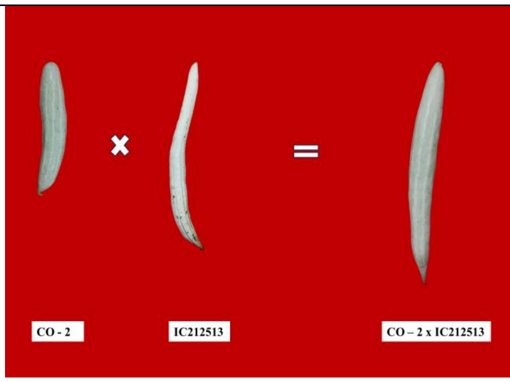

Fig. 3. Promising hybrid in the investigation.

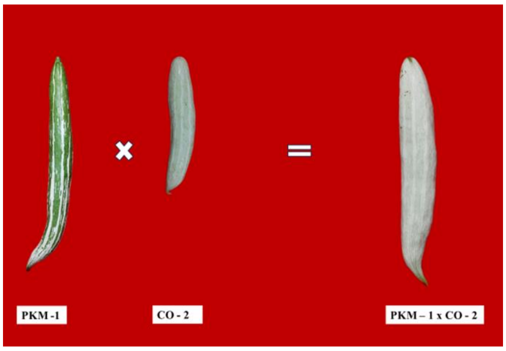

Fig. 4. Promising hybrid in the investigation.

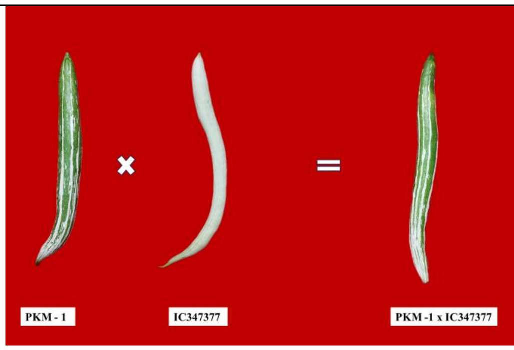

Fig. 5. Promising hybrid in the investigation.

CONCLUSIONS

In summary, following a comprehensive examination of six distinct parental varieties, Manusree and CO-2 have unequivocally emerged as strong general combiners, distinguished by their substantial contributions to both fruit yield and quality-related characteristics. These two varieties have consistently displayed exceptional performance across multiple key attributes, underscoring their significance in breeding programs aimed at enhancing the overall quality and productivity of the crop.

Among the specific crossbreed combinations, Manusree × Kaumudi has exhibited exceptional characteristics in terms of fruit length and average fruit weight, demonstrating a synergistic effect that augments these essential quality metrics. Conversely, PKM-1 × Manusree has proven to be highly effective in enhancing fruit girth, while Manusree × CO-2 has shown remarkable potential in terms of both the number of fruits per vine and overall fruit yield per vine.

These findings represent a valuable foundation for future breeding initiatives, offering essential insights and benchmarks for the development of improved snake gourd varieties. The selection of strong general combiners and the identification of specific cross combinations with desirable traits provide a structured approach to advancing the crop's genetic potential, ultimately benefiting the agricultural sector and ensuring the continued progress of snake gourd cultivation.

FUTURE SCOPE

The comprehensive and meticulous evaluation of promising hybrid combinations across a diverse array of trial locations, particularly in expansive plots, stands as an imperative facet in the process of ascertaining their true potential for eventual commercialization, specifically with regard to the harnessing of hybrid vigour. This endeavour encompasses the judicious utilization of parental plants in a multitude of breeding combinations, with the ensuing progeny subjected to an exacting and thorough screening process.

The objective is to pinpoint those individuals that manifest the full spectrum of desirable genetic traits inherent within the population. In this discerning process, the utilization of a pedigree-based selection approach assumes a pivotal role. It facilitates the precise identification and subsequent isolation of superior offspring emerging from the segregating generations.

These selected individuals, distinguished by their ability to consistently exhibit the desired genetic traits, undergo a developmental trajectory that culminates in the attainment of homozygosity. Upon reaching this critical state of genetic stability, these chosen individuals can be confidently introduced as entirely new cultivated varieties. This systematic and rigorous approach to breeding ensures not only the preservation but also the enhancement of desirable genetic characteristics, thereby contributing significantly to the ongoing progress and advancement of crop cultivation practices.

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