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Studies on the Performance of Bitter gourd (*Momordica charantia* L) Hybrids for Growth and Yield Attributes

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ABSTRACT: Vegetables are considered as essential one for a well-balanced diet. Karaikal is one of the regions of Union Territory of Puducherry located in the East Coast, almost at the end of the Cauvery Delta Zone. Diversification of cropping as an alternate to paddy is highly recommended for augumenting the farmers income and to sustain farming in this region. However, identification of suitable crop and variety to suit the existing soil and climatic conditions becomes essential. Since bitter gourd has a high nutritive and important among cucurbit vegetable it was chosen and the present investigation was carried out to study the *per se* performance of different bitter gourd hybrids in the Coastal condition of Karaikal for various growth and yield attributes. The study materials comprised of sixteen different bitter gourd hybrids assembled from various parts of the country and was performed at the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry, India. The study revealed the presence of significant differences among the hybrids evaluated for almost all the growth and yield contributing characters observed. Among the sixteen hybrids, the hybrid BGHS 8848 was found to record the best performance for days to first male flower anthesis (32.67) and days to first female flower anthesis (31.25) with the lowest values recorded. The hybrid NBGH 470 was found to produce both the first male (5.50) and female flower (7.17) at the lowermost nodes. For the character days to first fruit harvest the hybrid BGHS 4221 showed its best performance with 48.08 days while, BGHS 555 was found to record the longest duration with 149.17 days for final harvest. The hybrid Naveen with 17.72 primary branches at final harvest and BGHS 555 with a vine length of 5.11 m at final harvest were also found superior for these traits. Among the yield attributes, the fruit length was found maximum (24.11 cm) in NBGH 676, while fruit girth (14.51 cm), weight of individual fruit (146.26 gm) and flesh thickness (8.28 mm) were the highest in Pragati 065. The number of fruits vine^{-1} recorded was the maximum in NS 4501 (75.42), while the fruit yield vine^{-1} was found to be the highest in NBGH 676 (4.11 kg), recording an estimated yield of 38.02 t ha^{-1}. From the present investigation it is noticed that the hybrid NBGH 676 could be considered as the best hybrid based on the highest yield recorded for this region.

Keywords: Bitter gourd, F_1, hybrids, *per se* performance, growth and yield attributes.

INTRODUCTION

Vegetables are considered to be the vital component of a well-balanced diet. Vegetables make up a major proportion of the diet of human in many parts of the World and play a significant role in human nutrition, especially as sources of Phytonutraceuticals, vitamins, minerals and dietary fiber (Mohan, 2005). The phytochemicals from vegetables are strong antioxidants and are reported to reduce the risk of chronic diseases by protecting against free-radical damage, modified metabolic activation and detoxification of carcinogens and through influencing processes that could alter the course of tumor cells (Dias, 2012). India is the second largest producer of vegetables and the total area of vegetable cultivation in our country is around 10.10 m ha with a production of 185.88 m t (National Horticultural Board Statistics, 2018-19). Bitter gourd (*Momordica charantia* L.) is one of the important commercial cucurbits, belong to the largest vegetable family of Cucurbitaceae (Heiser, 1979). It is known in different names such as balsam pear or bitter cucumber in English and Karela in Hindi. It is popular throughout India for its tender fruits, which are consumed as boiled, curried, stuffed or sliced and fried (Singh *et al.* 2016). The fruit is also reported to be a good source of

vitamin C, iron, phosphorus and carbohydrates (Behera, 2004). Numerous medicinal properties of nearly all parts of the plant have been reported and the fruits are reported to be used as tonic, purgative, stomachic, carminative, anti-helminthic, anti-inflammatory, febrifuge, vulnerary, stimulant, thermogenic, anti-diabetic *etc*., (Longman, 1995). Many F_1 hybrids are popular in bitter gourd as in vegetable crops hybrids offer the advantage of earliness, high yield and quality. Hence, an attempt is made to assess the performance of bitter gourd hybrids to identify and recommend a suitable hybrid for farmers of this region.

MATERIAL AND METHODS

The experiment was conducted at Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, UT of Puducherry, India during Rabi Summer 2021. The material consisted of 16 different bitter gourd hybrids of various regions assembled from different sources of the country *viz.,* Palee, Pragati 065, Noor, NS 4501, NBGH 470, NBGH 676, NBGH 951, US 475, Abhishek, Vivek, BGHS 444, BGHS 555, BGHS 4221, BGHS 8848, Naveen and SS 5553. The experiment was laid out in a Randomized Block Design with three replications. Observations were recorded on five plants from each replication in each hybrid on various growth and yield contributing characters as suggested by Mahajan *et al.* (2000). The mean data was subjected to statistical analysis as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

A. Growth characters

Statistically analyzed mean data of the experiment revealed the presence of significant differences among the hybrids for most of the growth contributing characters studied. The *per se* performance of bitter gourd hybrids for growth attributes is presented in Table 1. The mean value for total number of days taken from sowing to first male flower anthesis among the 16 hybrids ranged from 32.67 (BGHS 8848) to 59.50 (Vivek) with a grand mean of 42.72 days and this range was in conformity with Singh and Kandaswamy (2020). Seven of the 16 hybrids *viz.,* BGHS 8848 (32.67), BGHS 4221 (34.67), NBGH 470 (36.07), NBGH 676 (37.13), US 475 (38.00), BGHS 444(40.33) and BGHS 555 (40.42) were found to record significantly lower values over the grand mean for this character. The mean for days to first female flower anthesis was observed to be 46.16 and it ranged between 31.25 (BGHS 8848) to 63.25 (Vivek). Among the hybrids studied five hybrids *viz.*, BGHS 8848 (31.25), NBGH 470 (39.27), US 475 (40.50), NS 4501 (41.25) and NBGH 951 (43.47) were found show highly significant superior performance over grand mean on desired direction while, NBGH 676 (43.57) was found to be significantly earlier compared to the grand mean observed for this trait.

Table 1: Mean performance of bitter gourd hybrids for growth attributes.

Sr. No.	Hybrids	Days to first male flower anthesis	Days to first female flower anthesis	Node bearing first male flower	Node Bearing First Female flower	Days to first fruit harvest	Days to final harvest	Number of primary branches vine^{-1} at final harvest	Vine length at final harvest (m)
1.	NBGH 676	37.13**	43.57*	6.25**	12.00	59.15	128.67	15.03**	3.82**
2.	NBGH 951	43.33	43.47**	7.87	10.93**	57.33*	122.93	14.20**	3.94**
3.	NS 4501	44.58	41.25**	6.83*	7.17**	55.83**	122.25	12.83	2.75
4.	NBGH 470	36.07**	39.27**	5.50**	7.17**	56.32**	121.60	14.70**	2.90
5.	Naveen	42.56	50.61	7.28	12.67	59.96	124.60	17.72**	4.24**
6.	Pragati 065	45.33	51.11	7.83	11.00**	61.36	122.67	14.61**	4.48**
7.	Abhishek	51.75	51.58	7.17	14.92	71.83	123.50	13.80	2.80
8.	US 475	38.00**	40.50**	7.00	11.75	55.33**	121.67	15.00**	3.63
9.	Noor	44.98	51.08	8.67	13.33	61.42	121.42	13.07	3.64
10.	Palee	46.17	49.67	8.08	13.00	60.58	120.50	14.73**	3.70**
11.	BGHS 444	40.33**	44.50	7.00	13.08	67.67	121.17	11.00	1.84
12.	Vivek	59.50	63.25	7.50	10.83**	75.58	122.83	15.58**	3.17
13.	BGHS 555	40.42**	44.33	13.08	14.58	51.50**	149.17**	9.78	5.11**
14.	BGHS 4221	34.67**	44.92	5.83**	19.50	48.08**	129.00	7.75	2.36
15.	BGHS 8848	32.67**	31.25**	9.67	14.42	48.42**	140.83**	11.23	2.54
16.	SS 5553	46.08	48.17	9.42	15.42	56.00**	133.67**	10.68	3.32
	Grand mean	42.72	46.16	7.81	12.61	59.15	126.65	13.23	3.39
	S. Ed	0.82	0.96	0.42	0.46	0.79	2.16	0.33	0.12
	CD (P= 0.05)	1.68	1.96	0.85	0.94	1.61	4.41	0.66	0.25
	CD (P= 0.01)	2.27	2.64	1.14	1.26	2.17	5.94	0.89	0.34

* Significant ; ** highly significant

The mean for node to first male flower anthesis ranged from 5.50 (NBGH 470) to 13.08 (BGHS 555) which found to be in conformity with earlier findings of Singh and Kandaswamy (2020) with a over all of mean 7.81days and three of the sixteen hybrids studied *viz.*, NBGH 470 (5.50), BGHS 4221 (5.83) and NBGH 676

(6.25) recorded highly significant lower values compared to the grand mean. Node bearing first female flower anthesis was found to range between 7.17 (NBGH 470 and NS 4501) to 19.50 (BGHS 4221) as evidenced from Table 1 which was also in conformity with Singh and Kandaswamy (2020). Five hybrids *viz.,* NBGH 470 (7.17), NS 4501 (7.17), Vivek (10.83), NBGH 951 (10.93) and Pragati 065 (11.00) were found to record significantly lower values over the grand mean (12.61) observed for this trait.

The number of days taken for the harvest of first fruit ranged between 48.08 (BGHS 4221) to 75.58 (Vivek) and the range was already been reported by Tyagi *et al*. (2018b) and eight hybrids were found to record significantly lower values over the grand mean of 59.15. The hybrid BGHS 8848 (48.42) was found to be the second best hybrid followed by BGHS 555 (51.50). For the character days to final harvest the range observed was from 120.50 in Palee to 149.17 in BGHS 555. Only three hybrids were found to record significantly higher values over the grand mean (126.65) and they were BGHS 555 (149.17), BGHS 8848 (140.83) and SS 5553 (133.67).

For the character number of primary branches vine^{-1} at final harvest the mean observed was 13.23 and the range was 7.75 to 17.72 and this range was already observed by Singh and Kandaswamy (2020). It was maximum Naveen (17.72) and was the least in BGHS 4221 (7.75). Eight genotypes were found superior with significantly higher values over the grand mean. The hybrid Vivek (15.58) was found to be the second best, followed by NBGH 676 (15.03). Vine length at final harvest was found to range from 1.84 m in BGHS 444 to 5.11 m in BGHS 555 (Table 1) which was in conformity with Singh and Kandaswamy (2020). Six of the 16 hybrids namely BGHS 555 (5.11 m), Pragati 065 (4.48 m), Naveen (4.24 m), NBGH 951 (3.94 m), NBGH 676 (3.82 m) and Palee (3.70 m) were found to record significantly higher values than the grand mean (3.39).

B. Yield characters

The fruit length observed among the bitter gourd hybrids was found to vary from 8.17 cm (SS 5553) to 24.11 cm (NBGH 676) as given in Table 2 and this variation in length of bitter gourd fruits were in conformity with Chaudhary *et al*. (2018); Kumari *et al*. (2018); Reddy and Singh (2019). Eight genotypes were found to produce significantly longer fruits compared to the grand mean of 17.16 cm and they were NBGH 676 (24.11 cm), BGHS 444 (22.01 cm), Palee (21.07 cm), NBGH 470 (20.86 cm), Naveen (20.77 cm), NBGH 951 (20.04 cm), US 475 (19.99 cm) and Pragati 065 (19.50 cm). The fruit girth ranged from 8.60 cm in BGHS 444 to 14.51 cm in Pragati 065 among the 16 hybrids evaluated and the grand mean observed for this trait was 11.89 cm and this range in fruit girth was observed earlier by Pradhan*et al*. (2021). Four of the 16 hybrids produced fruits of greater girth compared to grand mean and they were Pragati 065 (14.51 cm), Noor (13.55 cm), Palee (13.14 cm) and NBGH 951 (12.83 cm). For the character weight of individual fruit, the mean observed was 82.16 g with a range of 23.84 g in SS 5553 to 146.26 g in Pragati 065 which also coincides with the earlier findings of Reddy and Singh (2019). Among the 16 hybrids evaluated, nine hybrids were found to produce significantly greater fruit weight over the mean and hybrid Palee (118.09 g) was found to be the second best.

Table 2: Mean performance of bitter gourd hybrids for yield attributes.

Sr. No.	Hybrids	Fruit length (cm)	Fruit girth (cm)	Weight of individual fruit (g)	Flesh thickness (mm)	Number of fruits vine^{-1}	Fruit yield vine^{-1} (kg)	Estimated yield (t ha^{-1})
1.	NBGH 676	24.11**	11.21	91.07**	6.76	66.62**	4.11**	38.02
2.	NBGH 951	20.04**	12.83*	91.95**	7.32**	45.04**	3.04**	28.10
3.	NS 4501	8.81	12.59	35.83	6.96	75.42**	1.76	16.32
4.	NBGH 470	20.86**	11.39	90.57**	6.65	49.00**	3.88**	35.90
5.	Naveen	20.77**	12.63	114.10**	7.44**	44.91**	2.44*	22.58
6.	Pragati 065	19.50**	14.51**	146.26**	8.28**	37.78	3.07**	28.41
7.	Abhishek	16.17	13.15	85.50*	7.73**	28.17	3.26**	30.12
8.	US 475	19.99**	12.60	111.51**	6.74	33.33	2.26	20.89
9.	Noor	16.89	13.55**	89.20**	7.79**	29.92	3.29**	30.43
10.	Palee	21.07**	13.14**	118.09**	7.63**	27.00	2.16	19.98
11.	BGHS 444	22.01**	8.60	67.13	6.83	15.00	0.71	6.57
12.	Vivek	15.48	11.48	76.81	7.34**	23.42	1.33	12.31
13.	BGHS 555	13.58	9.43	42.49	6.84	23.25	1.06	9.77
14.	BGHS 4221	15.20	11.77	84.75	7.03	13.17	1.22	11.26
15.	BGHS 8848	11.87	9.92	44.52	6.10	29.50	1.10	10.16
16.	SS 5553	8.17	11.47	23.84	5.03	35.57	0.90	8.35
	Grand mean	17.16	11.89	82.16	7.03	36.07	2.22	20.57
	S. Ed	0.25	0.37	1.43	0.09	0.91	0.09	0.85
	CD (P= 0.05)	0.52	0.75	2.92	0.18	1.87	0.19	1.74
	CD (P= 0.01)	0.70	1.01	3.94	0.25	2.51	0.25	2.34

The thickness of the flesh among the bitter gourd hybrids in the present study was assessed to range from 5.03 mm (SS 5553) to 8.28 mm (Pragati 065). The grand mean observed was 7.03 mm and seven hybrids were found to record significantly greater values than the mean and the hybrids were Pragati 065 (8.28 mm),

Noor (7.79 mm), Abhishek (7.73 mm), Palee (7.63 mm), Naveen (7.44 mm), Vivek (7.34 mm) and NBGH 951 (7.32 mm).

The maximum number of fruits were observed in NS 4501 (75.42) and it was the minimum in BGHS 4221 (13.17). The grand mean was found to be 36.07 and five of the 16 hybrids evaluated *viz.,* NS 4501 (75.42), NBGH 676 (66.62), NBGH 470 (49.00), NBGH 951 (45.04) and Naveen (44.91) were found to produce significantly higher number of fruits compared to mean. The yield of fruits vine^{-1} was found to range between 0.71 kg in BGHS 444 to 4.11 kg in NBGH 676. It was also observed that seven genotypes have produced significantly greater yield over the grand mean (2.22 kg) and they were NBGH 676 (4.11 kg), NBGH 470 (3.88 kg), Noor (3.29 kg), Abhishek (3.26 kg), Pragati 065 (3.07 kg), NBGH 951 (3.04 kg) and Naveen (2.44 kg). The estimated yield for the hybrid NBGH 676 was 38.02 t ha^{-1} and it was the least in BGHS 444 (6.57 t ha^{-1}) as seen from Table 2.

The hybrids were given score based on their superiority with respect to each trait in comparison to the grand mean and the total score obtained by each hybrid in comparison to the grand mean for all the 14 traits observed is presented in Table 3.

Table 3: Score chart on mean performance of bitter gourd hybrids.

Sr. No.	Hybrids	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	Overall score
1.	NBGH 676	1	1	1	-	-	1	-	1	1	-	1	1	-	1	9
2.	NBGH 951	-	1	-	1	1	1	1	1	1	1	1	1	-	1	11
3.	NS 4501	-	1	1	1	1	-	-	1	-	-	-	-	-	-	5
4.	NBGH 470	1	1	1	1	1	1	-	1	1	-	1	-	-	1	10
5.	Naveen	-	-	-	-	-	1	-	1	1	1	1	1	-	1	7
6.	Pragati 065	-	-	-	1	-	1	1	-	1	1	1	1	-	1	8
7.	Abhishek	-	-	-	-	-	-	-	-	1	1	-	-	-	1	3
8.	US 475	1	1	-	-	1	1	-	-	1	-	1	-	-	-	6
9.	Noor	-	-	-	-	-	-	1	-	1	1	-	-	-	1	4
10.	Palee	-	-	-	-	-	1	1	-	1	1	1	1	-	-	6
11.	BGHS 444	1	-	-	-	-	1	-	-	-	-	-	-	-	-	2
12.	VIVEK	-	-	-	1	-	-	-	-	-	1	1	-	-	-	3
13.	BGHS 555	1	-	-	-	1	-	-	-	-	-	-	1	1	-	4
14.	BGHS 4221	1	-	1	-	1	-	-	-	-	-	-	-	-	-	3
15.	BGHS 8848	1	1	-	-	1	-	-	-	-	-	-	-	1	-	4
16.	SS 5553	-	-	-	-	1	-	-	-	-	-	-	-	1	-	2
No. of hybrids		7	6	4	5	8	8	4	5	9	7	8	6	3	7	

CONCLUSION

Based on the score value (Table 3) the hybrid NBGH 951 was found to superior with a score of 11 out of 16. However, based on the yield the bitter gourd hybrid NBGH 676 could be designated as the best with an yield of 4.11 kg vine^{-1}, followed by NBGH 470 (3.88 kg vine^{-1}). This particular hybrid NBGH 676 has been identified as a high yielding hybrid under Karaikal condition which is having biotic stress like salinity, this research study will be useful in suggesting the cultivation of this kind of hybrids in similar situation. Hence, the hybrid NBGH 676 could be commercially recommended for cultivation in this region.

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Conflict of Interest. None.

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