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Research Article

Performance of bitter gourd genotypes (*Momordica charantia var.muricata* L.) for higher yield and quality traits under sodic soil condition cultivar mithi pagal

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Abstract
The present investigation was carried out at Horticultural college and Research Institute for Women, Tamil Nadu Agricultural University, Trichy during *Kharif* 2017 with 30 mithipagal (*Momordica charantia var. muricata*.L) collected from different parts of Tamil Nadu to identify high yield and quality genotypes under sodic soil condition. Observation were recorded for the following traits *viz*, vine length, days to first male flower appearance, days to first female flower appearance, nodes of first male flower appearance, nodes of first female flower appearance, sex ratio, number of fruits per vine, fruit weight, fruit length, fruit girth, number of seeds per fruit, 100 seed weight, yield per vine, ascorbic acid, carotenoid content and total soluble solids. Among the genotypes MCM-19 was found to be the most promising genotype which recorded higher fruit yield per vine (0.72 kg) as well as other economic fruit yield components *viz*., fruit length (5.51 cm), fruit girth (6.47 cm), fruit weight (9.08 g), number of seeds per fruit (9.80), 100 seed weight (10.59 g) followed by MCM 22 and MCM 21. The highest total soluble solids was recorded in the genotypes MCM-4 (5.90 ^{0}brix) followed by MCM-21 (5.87 ^{0}brix), where as highest ascorbic acid was recorded in the genotypes MCM-26 (123.62 mg/100g) followed by MCM-22 (122.59 mg/100g). Hence selecting bitter gourd *var*. mithipagal genotypes with high fruit weight, more number of fruits per vine and seeds per fruit will help to improve yield per vine and quality of bitter gourd *var* fruits.

Key words
Performance, mithipagal, yield, quality and sodic soil

Introduction

Bitter gourd (*Momordica charantia* L.) also as called bitter melon, is a tropical and subtropical crop belonging to the family Cucurbitaceae which has 90 genera and 750 species (Ram, 2005). Bitter gourd (*Momordica charantia*) is a culinary bitter vegetable commonly used in traditional dishes in Bangladesh and Indian subcontinent. Bitter gourd can be found in different shapes and sizes. Generally, two varieties of bitter gourd are cultivated in India (*Momordica charantia* L.var.*charantia*) with large fruits (20–30cm) which are fusiform in shape and mithipagal (*Momordica charantia* L.var.*muricata* , Chakravarty,1990) which are identified by small (6-10 cm), round fruit. The small fruited *Momordica charantia* L.*var. muricata* types contain high amount of proteins, fats, carbohydrates and minerals (*i.e*., iron, calcium, vitamin C) than large fruited *Momordica charantia*.L. *var. charantia* types (Dey and Behera, 2006). The bitter flavour of both the varieties is due to the alkaloid momordicine produced in fruits and leaves which is different from cucurbitacin present in other cucurbits which has several uses. Fruits and seeds of mithipagal possess medicinal properties such as anti-HIV, anti-ulcer, anti-inflammatory, anti-leukemic, antimicrobial and antitumor.

Mithipagal (*Momordica charantia* L.var.*muricata)* is a wild type of bitter gourd cultivated in tropical and subtropical climates, the districts of Tamil Nadu and Kerala. Cytomorphological similarities in the two varieties which are cross-compatible indicate that attempts can be made to transfer desirable traits of *var. muricata viz*. drought tolerance and resistance against fruit fly into variety *charantia* by crossing experiments. Despite its importance, *var. muricata* is grown to limited extent in India and is found at few locations in the wild (Mehnaz Bano and Geeta Sharma, 2017). Tamil Nadu has a rich pool of mithipagal as a wild and cultivated type as well as homestead garden. There is a vast scope for growing this high valued crop in marginal lands where it gives fruits throughout the year. Owing to non availability of standard varieties, the farmers are cultivating only landraces which have low yield potential with variable fruit yield.

Further, the yield of crop depends upon number of yield components, characters; consideration on yield determinants simultaneously will be helpful in improving the efficacy of selection. Keeping this in view, the present investigation was undertaken to identify high yielding genotypes of mithipagal to

determine the interrelationship of biometrical and biochemical characters contributing to yield and quality characters of mithipagal.

Materials and Methods

The present investigation was carried out at Horticultural College and Research Institute for Women, Trichy during 2017–18. Totally thirty two genotypes were collected from different parts of Tamil Nadu were used for this study, the details of the genotypes are furnished in table 1.The experiment was laid out in Randomized Block Design with three replications. The soil of the experimental field was sodic, having sandy loam texture, with a pH of 9.00, EC 0.94 dSm-1 and ESP 21.76 per cent. Pits of 60 cm diameter and 30 cm depth were taken at a spacing of 2 x 1.5 m. The 30 genotypes (30 treatments) were replicated thrice and each replication consists of three pits. Before sowing, the seed were soaked in water for 12 hours to improve germination. Five seeds were sown in each pit. The plants were thinned to one seedling per pit after germination. 20 tonnes of FYM / ha recommended dose of basal fertilizer (6:12:12 g of NPK/plant) required, the cultural operations and plant protection measures were followed as per recommendation.

Observation were recorded on vine length, days to first male flower appearance, days to first female flower appearance, node of first male flower, node of first female flower, sex ratio, number of fruits per vine, individual fruit weight, fruit length, fruit girth, number of seeds per fruit, 100 seed weight, yield per plant, TSS, ascorbic acid, carotenoid content. The data were subjected to statistical analysis to obtain mean performance (Panse and Sukhatme, 1985).

Results and Discussion

Analysis of variance for 16 characters (Table 2) of bitter gourd *var* mithipagal revealed that mean squares due to genotypes were highly significant for all traits under study, thereby suggesting existence of great amount of variation among the genotypes.

So, there is a scope for considerable improvement in the crop through the characters studies such as vine length, days to first male flower appearance, days to first female flower appearance, node of first male flower, node of first female flower, sex ratio, number of fruits per vine, individual fruit weight, fruit length, fruit girth, number of seeds per fruit, 100 seed weight, yield per plant, TSS, ascorbic acid, carotenoid content. Similar to the present findings, significant differences for various characters was reported by Yadav *et al.,* (2013) and Singh *et al.,* (2017) in bitter gourd.

Vine length is considered as one of the important traits for growth and vigour of the plants. In the present investigation, the genotypes exhibited significant differences for vine length. Among the thirty genotypes of mithipagal MCM-17 recorded the highest vine length (3.75 m) and MCM-27 recorded the lowest vine length (1.45 m). The results are in line with the findings of Saranyadevi *et al.,* (2017), Jadhav *et al.,* (2009) and Singh *et al.,* (2018) in bitter gourd. Earliness is one of the main attributes which is measured in terms of days to first male and female flower appearance and it could be the accumulation of favourable genes. The genotype MCM-11 (54.83), took more number of days to produce first male flower which was on par with MCM-14 (51.83). While MCM-28 took least days (35.17) to produce first male flower appearance. The genotype, MCM-11 took 42.60 days to produce first female flower appearance where as MCM-18 recorded the least days (38.83) to produce first female flower appearance which was at par with MCM-27(42.50), MCM-30(42.58), MCM-10(42.60) and MCM-24(41.67) (Table 3). The results are in line with the findings of Saranyadevi *et al.,* (2017), Sundaram (2006) and Jadhav *et al.,* (2009) in bitter gourd.

Among the genotypes MCM-18 (3.75) recorded the lowest node value followed by MCM-11(4.25), MCM-8 (4.42) (Table 3). Female flowering is one of the main attribute for earliness. The genotype MCM-21 (12.50) was the earliest to produced female flower followed by MCM-5 (12.58), MCM-4 (13.17) and MCM-3 (13.75) (Table3). This was also in conformity to the report of Thangamani (2008) and Saranyadevi *et al.,* (2017) in mithipagal.

Estimation of sex ratio is highly essential for cucurbits which indicate the ability of the crop to set fruits. Low sex ratio is the favourable trait in cucurbits. The present study the genotype MCM-25 (10.85) was found to exhibit the lowest sex ratio, which was at par with MCM-19 (10.95), MCM-22 (12.38). The results are in line with the findings of Saranyadevi *et al.,* (2017) in mithipagal.

Number of fruits, fruit weight, fruit length and fruit diameter together form the most important closely related productivity parameters. The genotypes MCM-23 (89.67) was found to sproduce greatest number of fruits, which was at par with MCM-25 (84.07). The results are in line with the findings of Ratna Prabha *et al.,* (2007) in ridge gourd. The highest individual fruit weight was observed in MCM -21 (9.37 g) followed by MCM-19 (9.08 g) and the lowest was MCM-20 (3.19 g). This was also in conformity to the report of Singh *et al.,*

(2018) in bitter gourd. In case of fruit length, the longest fruit was noted in MCM-17 (8.22 cm) followed by MCM-19 (5.51 cm), whereas MCM - 21 (9.03 cm) recorded the highest fruit girth followed by MCM-22 (7.43 cm), MCM-17 (7.37 cm), MCM-25 (7.22 cm) (Table 3). The results are in line with the findings of Saranyadevi *et al.*, (2017) and Neelavathi *et al.*, (2015) in mithipagal.

Among the thirty genotypes, the highest number of seeds per fruit was observed in MCM-22 (13.80) followed by MCM-11 (12.27), MCM-17 (11.80), where as the highest 100 seed weight was observed in MCM-21 (13.17) followed by MCM-22 (12.71), MCM-23 (12.01). The highest fruit yield per vine was recorded in MCM-19 (0.72 kg) followed by MCM-22 (0.65 kg), MCM-21 (0.55kg). The results are in line with the findings of Saranyadevi *et al.*, (2017) in mithipagal and Garande *et al.*, (2017) in bottle gourd. The highest total soluble solids recorded in MCM-4 (5.90 ^{0}brix) followed by MCM-21 (5.87 ^{0}brix), MCM-14 (5.17 ^{0}brix). The results are in line with the findings of Ratna Prabha *et al.*, (2007) in ridge gourd and Saranyadevi *et al.*, (2017) in mithipagal. Ascorbic acid is a nutritionally important character and higher contents were observed in the genotype MCM-26 (123.62 mg/100g) followed by MCM-22 (122.59 mg/100g), MCM-20 (121.39 mg/100g). The results are in line with the findings of Saranyadevi *et al.*, (2017) in mithipagal, Singh *et al.*, (2018) in bitter gourd. Among the thirty genotypes, the highest amount of carotenoid content of 7.24 mg/100g was observed in MCM-21 followed by MCM-27 (6.72 mg/100g), MCM-15 (6.35 mg/100g) (Table 4). Similar results also reported by Zinash *et al.*, (2013) in pumpkin.

In the present investigation, based on *per se* performance, the genotypes MCM-19, MCM-22 and MCM-21 exhibited superior expression for most of the economic traits *viz*., vine length, sex ratio, number of fruits per vine, fruit weight, fruit length, fruit girth, TSS, yield per vine, ascorbic acid content and carotenoid content. These genotypes may be a good identification for higher production and productivity in sodic soil. These genotypes may be utilized as source for hybridization programme for further crop improvement.

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Table 1. Details and source of genotypes used for screening under sodic soil.

Genotypes	Source	Genotypes	Source
MCM -1	Allampati local	MCM -16	Perundhurai local
MCM -2	Karamani kuppam local	MCM-17	Amathur local
MCM -3	Pudhupatti local	MCM-18	Kuthallam local
MCM -4	Tamilpaddy local	MCM-19	Naduvakurichi local
MCM -5	Rajapalayam local	MCM-20	Sathirakootaikanmai
MCM -6	Pattukottai local	MCM-21	Aruppkottai local
MCM -7	Sathur local	MCM-22	Puthiyamputhur local
MCM -8	Dindigul local	MCM-23	Vilathikulam local
MCM -9	Tirunelveli local	MCM-24	Chithamparam local
MCM -10	Aladipatti local	MCM-25	Melapatti local
MCM -11	Mannarkudi, local	MCM-26	Narasingam local
MCM -12	Varachur local	MCM-27	Pandavurmangalam,
MCM -13	Cuddalore local	MCM-28	Alanganallur local
MCM -14	Suryanarayanamangalam	MCM-29	Thirumangalam local
MCM -15	Kovilpatti local	MCM-30	Karisalkulam local

MCM- ***Momordica charantia var muricata***

Table 2. Analysis of variance for different characters in bitter gourd *var* mithipagal genotypes

S.No	Characters	Replication mean sum of squares	Genotype mean sum of squares	Error mean sum of squares
1.	Vine length (m)	0.07	0.97**	0.007
2.	Node of first male flower	0.55	6.15**	0.32
3.	Node of first female flower	0.14	8.71**	0.73
4.	Days to first male flowering	13.34	58.18**	3.68
5.	Days to first female flowering	0.58	62.82**	4.57
6.	Sex ratio (m/f)	1.09	101.21**	0.95
7.	Fruit girth (cm)	0.08	1.92**	0.08
8.	Fruit weight (g)	0.94	8.75**	0.19
9.	Fruit length (cm)	0.18	2.83**	0.06
10.	Number of fruits per plant	109.66	1092.68**	25.49
11.	Number of seeds per fruit	0.24	22.75**	0.23
12.	100 seed weight (g)	0.01	8.11**	0.005
13.	TSS (^{0} Brix)	0.01	2.07**	0.01
14.	Ascorbic acid (mg/g)	1.06	1059.88**	0.37
15.	Carotenoid (mg/g)	0.03	6.87**	0.004
16.	Yield per plant (kg)	0.004	0.061**	0.003

****Significant at 1% level**

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Table 3. *Per se* performance for bitter gourd *var* mithipagal genotypes for yield and quality traits

Genotypes	Vine length (m)	Node of first male flower	Node of first female flower	Days to first male flowering	Days to first female flowering	Sex ratio (m/f)	Fruit girth (cm)	Fruit weight (g)
MCM-1	2.37	7.27	14.53	39.77	44.17	23.74	6.95	7.29
MCM-2	2.22	5.49	17.42	45.08	46.17	20.92	6.53	5.29
MCM-3	2.25	6.25	13.75	43.83	50.00	31.79	5.52	6.27
MCM-4	3.06	5.33	13.17	43.25	47.92	18.73	7.07	6.36
MCM-5	2.39	5.07	12.58	43.60	44.33	16.72	6.59	5.22
MCM-6	1.51	6.13	16.08	44.67	45.75	25.17	6.38	5.77
MCM-7	1.70	5.60	14.58	43.92	49.50	15.60	6.02	4.09
MCM-8	1.79	4.42	13.67	45.00	52.33	28.53	5.88	3.94
MCM-9	2.44	6.92	18.42	43.17	48.92	20.93	5.43	8.35
MCM-10	2.23	5.93	14.67	39.58	42.60	15.86	6.71	7.05
MCM-11	3.00	4.25	20.08	54.83	60.50	13.65	6.01	5.11
MCM-12	1.65	5.47	14.42	40.87	45.23	18.23	5.67	5.75
MCM-13	1.78	4.92	15.25	42.92	45.50	19.60	6.23	3.87
MCM-14	1.64	6.33	14.00	51.83	55.42	15.48	6.67	4.88
MCM-15	2.05	5.00	16.75	39.50	46.75	27.02	6.86	8.46
MCM-16	1.50	5.50	14.67	41.50	45.83	22.61	5.36	4.13
MCM-17	3.75	7.50	14.92	38.00	46.75	30.28	7.37	8.60
MCM-18	1.78	3.75	14.08	37.45	38.83	25.19	5.90	6.31
MCM-19	3.44	6.92	17.92	42.25	46.17	10.95	6.47	9.08
MCM-20	2.32	5.17	14.00	47.92	53.00	12.52	4.78	3.19
MCM-21	2.56	5.33	12.50	43.58	44.92	28.08	9.03	9.37
MCM-22	2.27	10.08	15.33	42.92	43.40	12.38	7.43	8.11
MCM-23	2.56	5.75	14.58	51.08	53.92	16.98	6.69	4.69
MCM-24	2.30	7.92	15.33	37.25	41.67	23.95	7.19	5.03
MCM-25	1.84	7.58	16.00	41.67	46.08	10.85	7.22	5.39
MCM-26	2.28	8.75	14.25	39.47	44.50	17.45	6.30	5.62
MCM-27	1.45	7.42	16.50	37.75	42.50	20.20	6.14	5.18
MCM-28	2.57	6.67	16.25	35.17	39.58	16.03	6.54	4.04
MCM-29	1.93	8.33	15.75	39.92	44.08	14.69	6.79	6.09
MCM-30	1.62	7.17	14.50	41.67	42.58	17.85	6.90	4.15
Mean	**2.21**	**6.27**	**15.20**	**42.65**	**46.89**	**19.73**	**6.49**	**5.89**
SEd	**0.07**	**0.46**	**0.70**	**1.57**	**1.75**	**0.80**	**0.23**	**0.36**
CD(0.05)	**0.14**	**0.92**	**1.39**	**3.13**	**3.50**	**1.60**	**0.47**	**0.71**

Table 4. *Per se* performance for bitter gourd *var* mithipagal genotypes for yield and quality traits

Genotypes	Fruit length (cm)	No.of fruits/ vine	No.of seeds/ fruit	100 seed weight (g)	Yield of fruits/ vine (kg)	TSS (^{0} Brix)	Carotene (mg/100g)	Ascorbic acid (mg/100g)
MCM-1	5.91	43.33	8.47	11.33	0.303	4.13	2.74	94.30
MCM-2	4.29	49.67	5.27	11.11	0.257	3.70	5.43	108.29
MCM-3	5.11	27.40	4.67	9.12	0.174	3.90	5.76	85.80
MCM-4	4.51	46.33	7.53	11.49	0.297	5.90	2.51	84.99
MCM-5	3.96	43.47	4.80	10.58	0.239	4.83	3.11	81.03
MCM-6	4.81	33.40	4.40	10.32	0.193	3.97	5.92	113.10
MCM-7	3.61	40.80	4.73	10.63	0.152	2.63	3.24	82.87
MCM-8	3.82	26.80	2.80	11.37	0.105	3.90	5.10	87.32
MCM-9	5.18	32.00	4.33	8.05	0.440	4.10	6.10	82.74
MCM-10	4.73	62.80	9.27	11.18	0.416	3.93	3.72	118.21
MCM-11	4.57	65.53	12.27	5.43	0.328	4.60	2.69	90.20
MCM-12	4.03	39.40	5.00	9.27	0.219	5.53	3.17	103.96
MCM-13	3.99	49.00	5.73	10.35	0.189	2.40	5.33	76.83
MCM-14	3.81	52.07	8.53	6.31	0.254	5.17	4.17	97.55
MCM-15	5.53	22.73	4.60	10.61	0.192	4.97	6.35	87.08
MCM-16	2.95	35.53	4.47	9.16	0.148	3.97	4.35	81.43
MCM-17	8.22	25.53	11.80	11.12	0.224	3.67	3.75	90.50
MCM-18	4.15	43.27	7.13	9.62	0.275	4.13	2.54	96.20
MCM-19	5.51	78.33	9.80	10.59	0.717	3.10	2.29	92.77
MCM-20	3.80	77.73	4.53	11.53	0.246	3.50	3.61	121.39
MCM-21	5.33	61.07	8.20	13.17	0.547	5.87	7.24	102.75
MCM-22	5.38	78.73	13.80	12.71	0.648	3.77	5.41	122.59
MCM-23	3.84	89.67	4.40	12.01	0.416	3.53	2.81	88.10
MCM-24	4.09	70.67	6.93	9.36	0.355	4.07	2.40	107.33
MCM-25	4.24	84.07	5.60	11.97	0.451	3.63	3.76	120.25
MCM-26	4.78	51.60	4.87	9.57	0.262	3.40	4.33	123.62
MCM-27	4.04	60.80	4.07	9.89	0.306	4.27	6.72	91.64
MCM-28	4.23	71.73	3.93	10.03	0.289	3.17	5.45	80.86
MCM-29	4.27	59.73	4.93	10.39	0.360	4.03	6.32	78.94
MCM-30	3.81	73.53	4.60	9.54	0.300	4.23	2.37	82.79
Mean	**4.55**	**53.22**	**6.38**	**10.26**	**0.310**	**4.07**	**4.24**	**92.84**
SEd	**0.20**	**4.12**	**0.39**	**0.06**	**0.05**	**0.09**	**0.06**	**0.49**
CD(0.05)	**0.40**	**8.35**	**0.78**	**0.12**	**0.09**	**0.18**	**0.11**	**0.99**