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Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.3133>

## ASSESSMENT OF *PER SE* PERFORMANCE OF FRENCH MARIGOLD (*TAGETES PATULA* L.) GENOTYPES FOR GROWTH, FLOWERING AND YIELD TRAITS

Pratheeksha C.T.<sup>1\*</sup>, Balaji S. Kulkarni<sup>1</sup>, Satish D<sup>3</sup>. and Udaya T.V.<sup>1</sup>

<sup>1</sup>Department of Floriculture and Landscape Architecture, College of Horticulture, Bagalkot, Karnataka, India.

<sup>3</sup>Department of Biotechnology and Crop Improvement, College of Horticulture, Bagalkot, Karnataka, India.

\*Corresponding author email: [prathiflora@gmail.com](mailto:prathiflora@gmail.com)

(Date of Receiving-23-04-2024; Date of Acceptance-10-07-2024)

### ABSTRACT

An experiment was conducted with objective to evaluate French marigold genotypes for growth, flowering and yield traits at college of Horticulture, Bagalkot in a randomized block design with two replications during 2021-2022. Observations were recorded on each genotype for both qualitative and quantitative traits. The results revealed that, maximum plant height, plant spread in N-S, leaf length and width, flower yield per plant, flower yield per plot and flower yield per hectare was observed in genotype Pusa Arpita. Maximum plant spread in E-W direction was recorded in the genotype UHSFm-6. More number of primary branches were noticed in IIHR-411 and secondary branches in IC-250321. The genotype UHSFm-10 had taken minimum number of days to first flowering. UHSFm-8 has taken least number days to 50 percent flowering. Maximum number of flowers per plant were recorded in Pusa Deep (175.77), whereas flower yield per plant, flower yield per plot and flower yield per ha were recorded in Pusa Arpita (500.32 g, 15.58 kg and 18.38 t).

**Key words:** French marigold, genotype, flower yield, growth parameters,

### Introduction

Marigold, a member of the Asteraceae family, native to South and Central America, especially Mexico. The marigold (*Tagetes* spp.), one of the most significant commercial flowers grown worldwide and is highly priced for its magnificent flower, radiant colour, beautiful appearance, myriad sizes, shape, form, fragrance and many different areas of commercial possibilities in the industrial and medicinal fields. (Priyambada *et al.*, 2015). The genus *Tagetes* contains 33 species, but only two are grown commercially: *Tagetes erecta* L., also known as African marigold, and *Tagetes patula* L., also known as French marigold. Because of their varying blossom heights and colours, these two species are used in landscape architecture and loose flower supply.

Marigold stands first among the traditional flower crops grown in India, accounting for more than half of the nation's loose flower production. Marigold is being cultivated in most of the states with an area of 66.13

thousand ha with a production of 603.18 thousand MT (Anumala and Kumar, 2021). It is cultivated in Karnataka as well and is the second largest growing state with an area of 12.10 thousand ha and the production is up to 121.93 thousand MT after Madhya Pradesh accounting 14 thousand ha and 224.87 thousand MT followed by Gujarat, Andhra Pradesh, Haryana, West Bengal and Maharashtra (Anon., 2019).

French marigolds are essential to landscaping because they provide rich colours ranging from deep orange and red to bright yellow, as well as acting as a natural insect repellent that improves the health and vitality of neighbouring plants. They are great for creating eye-catching borders, filling in gaps in garden beds, or providing pops of colour to container gardens because of their small size and profuse blooming. Beyond aesthetic value, they have capacity to repel harmful insects and attract beneficial pollinators which helps to maintain an ecologically balanced environment. Even though crop is

**Table 1:** Details of French marigold genotypes used in the experiment.

S. No.	Genotypes	Source of collection
1	Pusa Arpita	IARI, New Delhi
2	Pusa Deep	IARI, New Delhi
3	Fine Grow Dwarf Mix	Lalbagh, Bengaluru
4	IC-250303	IIHR, Bengaluru
5	IC-250323	IIHR, Bengaluru
6	IC-250321	IIHR, Bengaluru
7	IC-250325	IIHR, Bengaluru
8	UHSFm-1	UHS, Bagalkot
9	UHSFm-2	UHS, Bagalkot
10	UHSFm-3	UHS, Bagalkot
11	UHSFm-4	UHS, Bagalkot
12	UHSFm-5	UHS, Bagalkot
13	UHSFm-6	UHS, Bagalkot
14	UHSFm-7	UHS, Bagalkot
15	UHSFm-8	UHS, Bagalkot
16	UHSFm-10	UHS, Bagalkot
17	IIHRFm-411	IIHR, Bengaluru
18	IIHRFm-184	IIHR, Bengaluru
19	IC-250310	IIHR, Bengaluru
20	Bonanza Mix	IAHS, Bengaluru
21	IIHRFm-13	IIHR, Bengaluru
22	IC-250322	IIHR, Bengaluru
23	IC-250332	IIHR, Bengaluru
24	IC-250316	IIHR, Bengaluru
25	UHSFm-9	UHS, Bagalkot

gaining economic significance, but improved varieties not available to farmers for cultivation. Hence there is urgent need to develop high yielding French marigold genotypes with better quality traits. Keeping these things in view, present investigation was undertaken with objective to evaluate set of French marigold genotypes for productivity and quality traits.

### Materials and Method

The present investigation was conducted at experimental block of College of Horticulture, Bagalkot during 2021-22. Bagalkot is located in Northern dry zone region comes under zone 3 region-2 in the agro climatic zone of Karnataka state at an altitude of 542.0 m above mean sea level, with North latitude of 16.18° and East longitude of 75.7°. All recommended package of practices were carried out to grow the successful crop.

#### Experimental details

The experiment was laid out in a Randomized Complete Block Design (RCBD) with two replications. Each genotype consists of 30 plants per treatment and per replication.

**Location of study :** Department of Floriculture and Landscape Architecture, COH, Bagalkot

**Design :** RCBD

**Genotypes :** 25

**Replications :** 02

**Spacing :** 60 × 45 cm

#### Collection of experimental data

The data were collected on various parameters of vegetative, flowering and flower yield from the five randomly tagged plants in each plot.

#### Statistical analysis

Total 25 genotypes were used for the experiment (Table 1). The data on various biometrical parameters recorded during the period of investigation was subjected to statistical analysis as per the procedure given by Panse and Sukhatme (2002). The results have been presented and discussed at the five per cent probability level.

#### Analysis of Variance

Variance is the measure of variability and is defined as the average of the square deviation from the mean. It helps in working out the variance due to different source and also provides the basis for test significant (Singh and Choudhary, 1977).

Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (2002) using the mean values of random plant in each replication from all treatments to find out the significance of treatment effect.

Source of variation	Degrees of freedom (df)	Sum of square	Mean sum of square	Cal. F
Replication	(r-1)	RSS	RSS/(r-1)	RMSS/EMSS
Treatments	(t-1)	TrSS	TrSS/(t-1)	TrMSS/EMSS
Error	(r-1)(t-1)	ESS	ESS/(t-1)(r-1)	
Total	(rt-1)	TSS		

Where,

r = number of replications

t = number of genotypes

RSS = Mean sum of square of replication

TrMSS = Mean sum of square of genotypes

EMSS = Mean sum of square of error

The significance of treatment mean squares and replication mean squares were tested by comparing Cal. F with Table 'F' values at 5 and 1 per cent level of probability.

**Table 2:** Analysis of variance for different characters in French marigold .

S.No	Character Degrees of freedom	Mean sum of squares				
		Replication	Genotypes	Error	S.Em(±)	CD@5%
		1	24	24		
1	Plant height (cm)	303.11	152.22**	0.75	0.61	1.78
2	Plant spread [E-W] (cm)	284.56	110.87**	0.54	0.52	1.52
3	Plant spread [N-S] (cm)	280.39	77.13**	0.38	0.43	1.27
4	Primary branches	41.21	2.49**	0.01	0.08	0.24
5	Secondary branches	213.33	19.09**	0.15	0.28	0.81
6	Leaf length (cm)	13.51	17.66**	0.09	0.21	0.61
7	Leaf width (cm)	5.89	9.25**	0.05	0.15	0.44
8	Days to first flowering	832.87	97.06**	1.40	0.84	2.44
9	Days to 50% flowering	558.62	122.48**	0.60	0.55	1.60
10	Duration of flowering	539.24	10.95**	0.05	0.16	0.48
11	Number of flowers per plant	3642.34	695.84**	3.41	1.31	3.91
12	Individual flower weight (g)	0.69	1.96**	0.01	0.07	0.20
13	Flower diameter (mm)	321.93	37.34**	0.18	0.30	0.89
14	Shelf life (days)	2.92	1.16**	0.01	0.05	0.16
15	Flower yield per plant (g)	10262.16	26385.08**	129.29	8.04	23.47
16	Flower yield per plot (kg)	2.53	6.37**	0.01	0.07	0.21
17	Flower yield per hectare (t)	8.67	13.47**	0.02	0.10	0.30

## Result and Discussion

Collection, evaluation, and characterization of germplasm are the most important steps in a systemic breeding programme for acquiring basic knowledge on variability in a specific crop. Variation facilitates in the selection of a suitable genotype and breeding programme. The genetic variability that exists in a specific crop is a key factor in determining the source of any breeding programme for developing desirable varieties. Genetic diversity is necessary for the creation of an efficient plant breeding programme. The efficiency of selection depends greatly upon the magnitude of genetic variability existing in the plant population.

### Analysis of variance

The analysis of variance is presented in the Table 2 and it reveals presence of highly significant differences among the genotypes for all the traits studied and it is mainly due to genetic make of the individual genotype.

### Growth parameters

Various growth parameters such as plant height, plant spread, number of branches, leaf length and width were recorded in French marigold genotypes at grand growth stage (90 Days after planting). The *per se* performance of French marigold genotypes for various growth parameters was presented in Table 3. The plant height ranged from 25.50 to 60.50 cm (Table ). Maximum plant height (60.50 cm) was recorded in Pusa Arpita, which was shown to be superior among all the genotypes followed by IIHRFm-411 (51.90 cm) and UHSFm-6

(48.31 cm). However, Bonanza Mix has recorded the minimum plant height (25.50 cm). The plant spread in East-West direction ranged from 34.08 to 51.15 cm. UHSFm-6 had the greatest plant spread (51.15 cm) in the East-West direction, followed by IIHRFm-411 (50.02 cm) and Pusa Arpita (50.85). Further, Pusa Arpita had shown greatest plant spread (49.15 cm) in the North-South direction, followed by IIHRFm- 184 (39.80 cm). In Bonanza Mix and UHSFm-10, the minimal plant spread in both directions was obtained (26.42 cm in East-West and 26.19 cm in North-South direction, respectively). The mean range of primary branches varied from 10.48 to 15.57. The genotype IIHRFm-411 possessed the highest primary branches (15.57), followed by the genotypes UHSFm-6 (15.22) and Pusa Arpita (14.55). Bonanza Mix on the other hand had the minimum number of primary branches (10.48). The maximum number of secondary branches 30.05 were found in IC-250321 which was significantly superior to all other genotypes, followed by IIHRFm-411 (27.15) and Pusa Deep (26.20). The least number of secondary branches were found in UHSFm-9 (16.43). The leaf length values varied from 5.12 to 19.90 cm. Pusa Arpita had significantly longest leaf length (19.90 cm). The genotype IIHRFm-411 (11.52 cm) was in next place for longest leaf length compared to Pusa Deep (9.25 cm) and Fine Grow Dwarf Mix (8.87). In contrast, UHSFm-9 has the shortest leaf length (5.12 cm). The leaf width ranged from 3.48 to 12.87 cm. The maximum leaf width was observed in Pusa Arpita (12.87 cm), which was significantly highest among all the

**Table 3:** Mean performance of French marigold (*Tagetes patula* L.) genotypes for vegetative parameters.

S. No.	Genotypes	Plant height (cm)	Plant spread(cm)		No. of primary branches/ plant	No. of secondary branches/ plant	Leaf length (cm)	Leaf width (cm)
			E-W	N-S				
1	Pusa Arpita	60.50	50.85	49.15	14.55	20.45	19.90	12.87
2	Pusa Deep	44.30	44.36	43.9	12.45	26.2	9.25	5.89
3	Fine Grow Dwarf Mix	47.10	38.45	37.88	13.09	22.87	8.87	5.39
4	IC-250303	32.05	31.15	33.45	12.95	24.75	6.55	4.79
5	IC-250323	32.15	34.06	35.81	12.73	24.94	6.42	4.41
6	IC-250321	29.33	29.87	31.57	13.02	30.05	6.15	4.54
7	IC-250325	31.40	32.64	30.66	12.56	24.55	5.75	4.86
8	UHSFm-1	32.51	28.06	28.09	12.87	19.70	5.90	3.71
9	UHSFm-2	26.12	27.15	27.58	12.66	18.64	5.62	3.64
10	UHSFm-3	33.70	33.00	32.50	13.50	23.08	6.05	3.98
11	UHSFm-4	32.00	31.67	30.84	12.09	23.05	6.44	3.87
12	UHSFm-5	28.54	30.54	31.33	13.05	20.45	5.37	3.75
13	UHSFm-6	48.31	51.15	34.89	15.22	25.96	7.15	4.35
14	UHSFm-7	30.60	27.74	42.31	13.15	19.83	6.05	3.48
15	UHSFm-8	30.30	29.45	27.74	12.98	22.15	5.56	4.02
16	UHSFm-10	35.40	33.32	31.12	13.66	24.81	7.65	4.49
17	IIHRFm-411	51.90	50.02	36.45	15.57	27.15	11.52	10.55
18	IIHRFm-184	35.40	33.16	48.08	13.92	24.62	8.15	4.11
19	IC- 250310	40.15	35.01	30.55	13.45	26.03	6.74	4.67
20	Bonanza Mix	25.50	26.42	34.06	10.48	22.25	5.95	3.73
21	IIHRFm-13	33.30	36.70	29.48	11.59	21.88	7.80	4.35
22	IC- 250332	27.50	35.41	33.15	12.36	24.06	6.95	4.42
23	IC- 250316	29.80	29.07	32.90	11.57	20.33	6.70	4.51
24	IC- 250322-01	31.60	27.16	29.11	13.14	19.54	8.05	4.53
25	UHSFm-9	30.00	29.93	28.07	11.66	16.43	5.12	3.64
	<b>S.Em.±</b>	0.61	0.52	0.43	0.08	0.28	0.21	0.15
	<b>C.D at 5%</b>	1.88	1.52	1.27	0.24	0.81	0.61	0.44

genotypes. The genotypes IIHRFm-411 (10.55), Pusa Deep (5.89) and Fine Grow Dwarf Mix (5.39 cm) were next in the order for higher leaf width. Whereas, the minimum leaf width (3.48 cm) was seen in UHSFm-7.

The variation of these vegetative parameters among genotypes could be due to genetic variation and by the influence of climatic factors during the crop period. The results are correlated with the earlier findings of Verma *et al.*, (2004), Raghuvanshi and Sharma (2011), Kumar *et al.*, (2015), Gupta *et al.*, (2016), Mahantesh *et al.*, (2018) and Sharma *et al.*, (2019), Nagashree and Kulkarni (2019) and Preeti *et al.*, (2019) in marigold.

### Flowering parameters

The performance of French marigold genotypes for flowering parameters was presented in the Table 4. The perusal of results from Table 3 revealed the significant differences among the genotypes. Days to first flowering ranged between 27.60 to 60.20 days. A minimum number of days taken to first flower appearance was recorded in

genotype UHSFm-10 (27.60 days) followed by UHSFm-9 (29.50 days) and UHSFm-2 (29.80 days) and delayed flowering was observed in IIHRFm-411 (48.00 days) and Pusa Arpita (60.20 days) genotypes. The number of days required for 50% blooming varied from 39.50 to 71.50. Minimum days taken by the plants to reach 50% flowering was observed in the genotype UHSFm-8 (39.50 days) and it was on par with IC-250325 (40.30 days), followed by UHSFm-5 (41.10 days). The genotype IIHRFm411 (64.40 days) and Pusa Arpita (71.50 days) took maximum days to reach 50% flowering. The duration of flowering differed significantly among the genotypes and it was ranged from 40.40 days to 51.00 days. The genotype IC-250322 had the longest flowering duration (51.00 days) followed by Bonanza Mix (50.00 days) and UHSFm7 flowered for 48.70 days. Whereas, minimum flowering duration was observed in Pusa Arpita (40.40 days) and Pusa Deep (43.50 days).

The different time required for first flower opening in the different genotypes was due to varied growth rate,

**Table 4:** Mean performance of French marigold (*Tagetes patula* L.) genotypes for flowering parameters.

S. No.	Genotype	Days to first flowering (days)	Days to 50 % flowering (days)	Duration of flowering (days)
1	Pusa Arpita	60.20	71.50	40.40
2	Pusa Deep	33.40	45.20	43.50
3	Fine Grow Dwarf Mix	35.00	44.80	44.80
4	IC-250303	34.10	50.30	44.50
5	IC-250323	32.90	46.70	43.30
6	IC-250321	30.30	41.40	46.50
7	IC-250325	29.60	40.30	47.40
8	UHSFm-1	30.00	47.20	46.60
9	UHSFm-2	29.80	42.10	44.10
10	UHSFm-3	31.10	48.40	47.20
11	UHSFm-4	33.00	47.60	48.30
12	UHSFm-5	30.70	41.10	46.10
13	UHSFm-6	32.00	49.80	47.60
14	UHSFm-7	30.60	41.10	48.70
15	UHSFm-8	30.80	39.50	48.40
16	UHSFm-10	27.60	40.60	47.80
17	IIHRFm-411	48.00	64.40	47.50
18	IIHRFm-184	31.70	46.30	48.30
19	IC- 250310	32.00	43.70	48.00
20	Bonanza Mix	32.20	48.80	50.10
21	IIHRFm-13	33.00	49.40	48.80
22	IC- 250332	35.00	50.00	51.00
23	IC- 250316	33.10	48.10	48.00
24	IC- 250322-01	43.50	62.20	46.70
25	UHSFm-9	29.50	42.30	48.20
	S.Em.±	0.84	0.94	0.28
	C.D at 5%	2.55	2.84	0.84

their different genetic makeup and may be influence of solar radiation and temperature. Similarly, variations in flowering characters have been reported by Mahanthesh (2018) in marigold, Munikrishnappa (2011) and Zosiamlia *et al.*, (2012) in China aster.

### Yield parameters

There was significant difference among the genotypes for flower yield parameters under the study and the data is presented in Table 5.

The number of flowers per plant varied significantly among the genotypes. The Number of flowers per plant ranged from 94.95 to 175.70. The genotype Pusa Deep had the highest number of flowers per plant (175.70), followed by IIHRFm-411 (162.25) and Fine Grow Dwarf Mix (150.90). In contrast, the minimum number of flowers per plant were observed in IC-250322 - 01 (94.95). The

**Table 5:** Mean performance of French marigold (*Tagetes patula* L.) genotypes for yield parameters.

S.	Genotypes	No. of flowers /plant	Yield per plant (g)	Yield per plot (kg)	Yield per ha (t)
1	Pusa Arpita	105.15	500.32	15.58	18.38
2	Pusa Deep	175.70	468.85	14.66	17.25
3	Fine Grow Dwarf Mix	150.90	282.2	8.57	9.73
4	IC-250303	117.15	155.29	4.76	5.03
5	IC-250323	122.15	298.76	9.05	10.32
6	IC-250321	125.70	232.66	7.13	7.95
7	IC-250325	119.85	116.55	3.58	3.57
8	UHSFm-1	115.10	117.02	3.74	3.77
9	UHSFm-2	114.65	121.44	3.88	3.94
10	UHSFm-3	125.30	149.09	4.60	4.83
11	UHSFm-4	114.50	136.65	4.51	4.72
12	UHSFm-5	119.55	151.45	4.68	4.93
13	UHSFm-6	143.40	155.97	4.76	5.03
14	UHSFm-7	117.75	103.20	3.55	3.53
15	UHSFm-8	116.70	125.05	3.98	4.06
16	UHSFm-10	119.40	144.31	4.67	4.92
17	IIHRFm-411	162.25	336.63	10.15	11.68
18	IIHRFm-184	123.40	149.19	4.68	4.93
19	IC- 250310	121.15	190.7	5.81	6.32
20	Bonanza Mix	103.85	185.95	5.73	6.22
21	IIHRFm-13	120.40	188.87	5.8	6.31
22	IC- 250332	117.00	146.33	4.49	4.69
23	IC- 250316	98.35	134.71	4.36	4.53
24	IC- 250322-01	94.95	420.02	12.65	14.77
25	UHSFm-9	103.40	105.33	3.77	3.80
	S.Em.±	1.68	13.28	0.24	0.30
	C.D at 5%	5.04	40.23	0.76	0.89

flower yield (g/plant) ranged from 105.33g to 500.32 g. The higher flower yield was recorded in Pusa Arpita (500.32 g) followed by Pusa Deep (468.85 g), followed by genotypes IC- 250322-01 (420.02 g) and IIHRFm-411 (336.63g). While lowest flower yield was recorded in UHSFm-7 (103.20 g). The highest yield per plot was recorded in Pusa Arpita (15.58 kg) which was on par with Pusa Deep (14.66kg) followed by the genotype IC-250322-01 (12.65 kg) and IIHRFm-411 (10.15 kg). While, the lowest yield per plot was recorded in UHSFm-7 (3.55 kg). The maximum flower yield per ha was recorded in the genotype Pusa Arpita (18.38 t) compared to Pusa Deep (17.25 t) followed by IC- 25032201 (14.77 t) and IIHRFm-411 (11.68 t) and lowest yield was reported in UHSFm-7 (3.53 t).

The number of flowers on a plant directly correlates with its potential yield, as each flower has the potential to



develop into a fruit or seed. Maximizing the number of flowers per plant can significantly enhance agricultural productivity and overall crop yield. Difference in the photosynthetic efficiency of genotypes might have enhanced food accumulation resulting in better plant growth and subsequently higher number of flowers per plant (Sunitha *et al.*, 2007). The variation in number of flowers per plant might be due to hereditary traits of the genotypes. The findings of the study are also in accordance with those of Karuppaiah and Kumar (2011), Yuvraj and Dhatt (2014) and Manik and Sharma (2016) in marigold.

### Conclusion

After accomplishing a comprehensive assessment of the investigation's outcomes, it can be concluded that based on performance, the genotypes *viz.*, IHRFm-411, UHSFm-6, Pusa Arpita, Pusa Deep, UHSFm-10 and IC-250310 were superior w.r.t growth, flowering and yield. Hence, they can be further used for commercial cultivation and for future breeding programme. From present investigation, it can be concluded that, there is a scope to exploit the variation present among the genotypes with respect to growth and flowering characters to increase the genetic diversity of the crop.

### Acknowledgement

All the resources and facilities were provided by college of horticulture, Bagalkot, Karnataka for their incomparable help in conductance of the research is genuinely acknowledged.

**Conflict of Interest.** None.

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