**EVALUATION OF FRENCH MARIGOLD (*Tagetes patula* L.) VARIETIES FOR FLOWERING AND FLOWER QUALITY ATTRIBUTES.**

**ABSTRACT**

The present investigation was carried out at College of Horticulture, Sri Konda Laxman Telangana Horticultural University, Rajendranagar, Hyderabad during Rabi 2021-2022 and 2022-2023. The experiment was laid in completely randomized design with 5 treatments and 4 replications to study the flowering and flower quality attributes. Among five varieties, minimum number of days taken for first flower bud initiation (30.55 days), first flower bud opening (37.50 days), 50 percent flowering (51.14 days), full bloom (60.88 days), maximum number of flowers per plant (35.45), number of flowers per pot (105.00) were recorded in T5: Arka Pari. Weight of the flower (3.71 g) was recorded maximum in T2: Pusa Arpita. Maximum flower diameter (42.06 mm) and duration of flowering (47.70 days) were recorded in T3: Pusa Deep.

**Keywords:** *Tagetes patula* L., Varietal evaluation, Flowering and Flower quality attributes.

**Introduction:**

Marigold (*Tagetes* spp.) is one of the most important loose flower crop, belongs to the family Asteraceae and is native to the Mexico. The genus *Tagetes* consist of more than 50 species, out of these, *Tagetes erecta* (African marigold), *Tagetes patula* (French marigold) are very common and popular for commercial cultivation. India's demand for potted plants has expanded due to rapid urbanization and changing lifestyles. Marigold cultivation is becoming popular among flower nurseries and it is also becoming one of the most valuable pot flowering crops as it is easy to cultivate with wider adaptability. French marigold is ideal for bedding, herbaceous borders, pots, hanging baskets, window boxes and rockery. It requires mild climate for proper growth. It flowers within short crop duration producing wide range of attractive shapes, colors, sizes and long shelf life. French Marigold, being a more compact and bushy variety, is especially well-suited for pot culture. It typically exhibits early and profuse blooming, with smaller but numerous flowers, making it ideal for ornamental display in containers. Its flowers are known for their vivid color range. Varietal characterization and identification of specific traits have great role in any crops for quality seed production and good management practices (Pramila *et al.* 2011). This study was conducted to identify best French marigold variety for pot culture with best desirable traits.

**Materials and Methods:**

The present experiment was carried out at College of Horticulture, Rajendranagar, during Rabi seasons of 2021-2022 and 2022-2023. The experiment was laid in completely randomized design with 5 treatments and 4 replications to study the performance of 5 different french marigold varieties. Sowing was done in first fortnight of October for first season and second fortnight of September in second season in protrays. Seeds were sown in protrays with a media containing cocopeat and vermicompost in 1:1 ratio. Black PVC pots were taken, the media was prepared with a ratio of soil: cocopeat: FYM in 1:1:1, then pots were filled with this media. Thirty days old healthy seedlings were selected, three plants per pot were carefully transplanted in each pot. Data was recorded in terms of flowering and flower quality attributes. These parameters, were statistically analyzed.

1. **Flowering parameters**
2. **Number of days taken for first flower bud initiation**

 From table 1. It was found that the pooled data for number of days taken for first flower bud initiation were recorded minimum in T5: Arka Pari (30.55 days) which was on par with T4: CGFM-1 (31.63 days) followed by T3: Pusa deep (34.81 days), T1: Bidan Kali Gainda (45.28 days) and maximum was recorded in T2: Pusa Arpita (50.43 days). The time required for first flower bud appearance is a genotypic trait which is primarily controlled by genetic composition of a genotype. Earliness in flower bud initiation majorly depends on carbohydrates accumulation and also the capacity of a individual genotype to efficiently utilize the carbohydrates and proteins to produce flowers. More dry matter accumulation due to favorable climatic conditions might be the reason behind earliness in this trait (Beniwal and Dahiya, 2012). The observed result was consistent with previous findings of Dhiman (2003), Dilta *et al.* (2005) and Talukdar *et al.* (2006), Kavana *et al.* (2024) in chrysanthemum, Rao *et al.* (2005) and Nishitha (2022) in marigold.

1. **Number of days taken for first flower bud opening**

 From table 1. it was found that the pooled data on number of days taken for first flower bud opening were recorded minimum in T5: Arka Pari (37.50 days) which was followed by T4: CGFM-1 (38.86 days), T3: Pusa deep (43.49 days), T1: Bidan Kali Gainda (54.83 days) and maximum were recorded in T2: Pusa Arpita (59.13 days ). The variation in early or late flower opening may be attributed by inherent genetic factors. Similar observations were noted by Khanvilkar *et al.* (2003), Rao *et al.* (2005), Beniwal and Dahiya (2012), Mahantesh *et al.* (2016) Gaurav and Basavaraj (2021) and Nishitha, (2022) in marigold.

**1. Performance of french marigold (*Tagetes patula* L.) varieties with respect to number of days taken for first flower bud initiation (days) and number of days taken for first flower bud opening (days) during *Rabi* 2021-22 and 2022-23.**

|  |  |  |
| --- | --- | --- |
|  | **Number of days taken for flower bud initiation (days)** | **Number of days taken for flower bud opening (days)** |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 45.20 | 45.35 | 45.28 | 54.80 | 54.85 | 54.83 |
| **T2**: Pusa Arpita | 50.70 | 50.05 | 50.38 | 59.05 | 59.20 | 59.13 |
| **T3**: Pusa Deep  | 34.20 | 35.43 | 34.81 | 43.33 | 43.65 | 43.49 |
| **T4**: CGFM-1  | 31.30 | 31.95 | 31.63 | 38.98 | 38.75 | 38.86 |
| **T5**: Arka Pari | 30.25 | 30.85 | 30.55 | 37.95 | 37.05 | 37.50 |
| **SEm±** | 0.52 | 0.62 | 0.42 | 0.50 | 0.53 | 0.37 |
| **CD at 5 %** | 1.57 | 1.88 | 1.26 | 1.50 | 1.59 | 1.13 |

1. **Number of days taken for 50 percent flowering**

 From table 2. it was found that the pooled number of days taken for 50 percent flowering were recorded minimum in T5: Arka Pari (51.14 days) which was on par with T4: CGFM-1 (52.10 days) followed by T3: Pusa deep (57.61days), T1: Bidan Kali Gainda (66.89 days) and maximum days were recorded in T2: Pusa Arpita (69.11 days). The difference in flowering period by various genotypes might be due to their ancestral genotypic characters. The period required to produce 50 percent of flowers in Arka Pari is short, this might be due to the variety has reached its greater potential for 50 percent flower production within a short span. The earliest days taken for 50 percent flowering had been primarily dependent upon the food reserve in the plant and genotype-environment interaction leading to varied rates (Beniwal and Dahiya, 2012). The results corroborated with Nair and Shiva (2003) in gerbera and Suvija *et al.* (2016) in chrysanthemum, Khanvilkar *et al.* (2003), Rao *et al.* (2005), Singh and Mishra (2008), Gaurav and Basavaraj (2021) and Nishitha, (2022) in marigold.

**2. Performance of french marigold (*Tagetes patula* L.) varieties with respect to number of days taken for 50 per cent flowering (days) and number of days taken for full bloom (days) during *Rabi* 2021-22 and 2022-23.**

|  |  |  |
| --- | --- | --- |
|  | **Number of days taken for 50 per cent flowering (days)** | **Number of days taken for full bloom** **(days)**  |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 66.53 | 67.25 | 66.89 | 76.55 | 77.15 | 76.85 |
| **T2**: Pusa Arpita | 68.68 | 69.55 | 69.11 | 77.90 | 78.25 | 78.08 |
| **T3**: Pusa Deep  | 57.07 | 58.15 | 57.61 | 67.00 | 67.30 | 67.15 |
| **T4**: CGFM-1  | 51.90 | 52.30 | 52.10 | 60.70 | 61.65 | 61.18 |
| **T5**: Arka Pari | 50.88 | 51.40 | 51.14 | 60.15 | 61.60 | 60.88 |
| **SEm±** | 0.34 | 0.39 | 0.28 | 0.52 | 0.52 | 0.33 |
| **CD at 5 %** | 1.03 | 1.19 | 0.86 | 1.57 | 1.58 | 1.00 |

1. **Number of days taken for full bloom**

 From table 2. it was found that the pooled data on number of days taken for full bloom were recorded minimum in T5: Arka Pari (60.88 days) which was on par with T4: CGFM-1 (61.18 days) followed by T3: Pusa deep (67.15 days), T1: Bidan Kali Gainda (76.85 days) and maximum days were recorded in T2: Pusa Arpita (78.08 days). Precocity in flowering of a genotype might be due to a cultivar's distinct flowering behavior due to its genotypic makeup, which also accounts for the quantitative difference in the time taken for the full bloom. The variation in flowering period may be caused by inheritance of ancestral genotypic characters. The results coincided with Mahanta *et al.* (2020), Dahal *et al.* (2021) in marigold.

1. **Number of flowers per plant**

 From table 3. it was found that the pooled data on number of flowers per plant were recorded maximum in T5: Arka Pari (35.45) which was on par with T4: CGFM-1 (34.18) followed by T3: Pusa deep (30.40), T1: Bidan Kali Gainda (20.60) and minimum number of flowers were recorded in T2: Pusa Arpita (15.93). The maximum number of flowers per plant might be due to rapid cell division and cell elongation in reproductive phases. This cycles generally depend on specific genotypic trait of a individual variety. Similar findings were noted by Dilta *et al.* (2019) in azaleas, Kavana *et al.* (2024) in chrysanthemum, Choudhary *et al.* (2014), Bharathi and Jawaharlal (2014), Manoj *et al.* (2018) and Priya *et al.* (2022) in marigold.

1. **Number of flowers per pot**

 From table 3. it was found that the pooled data on number of flowers per pot were recorded maximum in T5: Arka Pari (105.00) which was followed by T4: CGFM-1 (102.13), T3: Pusa Deep (90.08), T1: Bidan Kali Gainda (65.10) and minimum number of flowers were recorded in T2: Pusa Arpita (45.70). Number of flowers is a quantitative trait which depends on specific genotype, Moreover, different varieties have different photosynthetic abilities, which can promote the accumulation of food, which increases the number of flowers per plant. Similar findings were noted by Dilta *et al.* (2019) in azaleas, Choudhary *et al.* (2014), Bharathi and Jawaharlal (2014), Manoj *et al.* (2018) and Priya *et al.* (2022), in marigold.

**3. Performance of French marigold (*Tagetes patula* L.) varieties with respect to number of flowers per plant and number of flowers per pot during *Rabi* 2021-22 and 2022-23.**

|  |  |  |
| --- | --- | --- |
|  | **Number of flowers per plant** | **Number of flowers per pot** |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 20.90 | 21.30 | 21.10 | 64.90 | 65.30 | 65.10 |
| **T2**: Pusa Arpita | 15.80 | 16.05 | 15.93 | 45.00 | 46.40 | 45.70 |
| **T3**: Pusa Deep  | 29.45 | 29.75 | 29.60 | 89.95 | 90.20 | 90.08 |
| **T4**: CGFM-1  | 34.10 | 34.25 | 34.18 | 101.20 | 103.05 | 102.13 |
| **T5**: Arka Pari | 35.40 | 35.50 | 35.45 | 104.05 | 105.95 | 105.00 |
| **SEm±** | 0.46 | 0.60 | 0.40 | 0.98 | 0.76 | 0.66 |
| **CD at 5 %** | 1.37 | 1.80 | 1.21 | 2.96 | 2.29 | 2.00 |

**II) Flower quality parameters**

1. **Diameter of flower (mm)**

 From table 4. maximum pooled data on flower diameter was observed in T3: Pusa Deep (42.06 mm) which was at par with T2: Pusa Arpita (41.68 mm) followed by T1: Bidan Kali Gainda (39.20 mm), T5: Arka Pari (35.08 mm) and minimum diameter was observed in T4: CGFM-1 (34.10 mm). The dissimilarities in flower diameter of various genotypes might be due to genotypic variations which may be governed by the inherent genetic as well as environmental factors. Maximum diameter of flower may possibly be due to increased dry matter accumulation during favorable climatic conditions (Rao and Reddy, 2002). The results commensurate with Patil *et al.* (2017) in chrysanthemum, Narsude *et al.* (2010), Shivakumar *et al.* (2014), Singh *et al.* (2014), Deepa *et al.* (2016), Naik *et al.* (2019), Kumar *et al.* (2020), Gaurav and Basavaraj (2021) in marigold.

**4. Performance of french marigold (*Tagetes patula* L.) varieties with respect to flower diameter (mm) during *Rabi* 2021-22 and 2022-23.**

|  |
| --- |
| **Diameter of flower (mm)** |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 39.03 | 39.33 | 39.20 |
| **T2**: Pusa Arpita | 41.55 | 41.76 | 41.68 |
| **T3**: Pusa Deep  | 42.27 | 42.96 | 42.61 |
| **T4**: CGFM-1  | 33.08 | 33.97 | 33.52 |
| **T5**: Arka Pari | 34.36 | 35.07 | 34.71 |
| **SEm±** | 0.62 | 0.65 | 0.55 |
| **CD at 5 %** | 1.87 | 1.97 | 1.66 |

1. **Weight of flower (g)**

 From table 5. maximum pooled data on weight of flower was observed in T2: Pusa Arpita (3.71 g), which was followed by T3: Pusa Deep (3.04 g), T1: Bidan Kali Gainda (3.02 g), T5: Arka Pari (2.47 g) and minimum weight was observed in T4: CGFM-1 (2.25 g). The differences in flower weight might be due to differences in size, length of flower and number of petals which are governed by different genes. Different varieties may absorb water at different rates than tranpiration levels, which may account for the variation in flower weight. The results coincide with Patil *et al.* (2017), Thakur and Dhatt (2023) in chrysanthemum, Narsude *et al.* (2010), Deepa *et al.* (2016) and Manoj *et al.* (2018) in marigold.

**5. Performance of french marigold (*Tagetes patula* L.) varieties with respect to flower weight (g) during *Rabi* 2021-22 and 2022-23.**

|  |
| --- |
| **Weight of flower (g)** |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 2.97 | 3.07 | 3.02 |
| **T2**: Pusa Arpita | 3.57 | 3.85 | 3.71 |
| **T3**: Pusa Deep  | 3.01 | 3.08 | 3.04 |
| **T4**: CGFM-1  | 2.11 | 2.23 | 2.17 |
| **T5**: Arka Pari | 2.19 | 2.76 | 2.47 |
| **SEm±** | 0.24 | 0.29 | 0.21 |
| **CD at 5 %** | 0.72 | 0.88 | 0.64 |

1. **Duration of flowering (days)**

 From table 6. pooled data on duration of flowering was observed maximum in T3: Pusa Deep (47.70 days), which was on par with T5: Arka Pari (46.83 days), T4: CGFM-1 (46.44 days) followed by T1: Bidan Kali Gainda (41.08 days) and minimum duration of flowering was observed in T2: Pusa Arpita (38.80 days). A genotype is more suitable for pot culture if it maintains its attractiveness for a longer period of time than short flowering period. Extended period of flowering could be due to high dry matter assimilation because of more nitrogen incorporation and other nutrients, nutrients uptake in addition to a prevailing favorable environment (Rao *et al.* 2005). Variation in duration may also be caused due to favorable climatic conditions which resulted into genetic control of the trait and modification in their expression in marigold (Panwar *et al.* 2013). Similar trend was noted by Kavana *et al.* (2024) in chrysanthemum, Khanvilkar *et al.* (2003), Raghuvanshi and Sharma, (2011), Choudhary *et al.* (2014), Gaurav and Basavaraj (2021) in marigold.

**4.1.13.** **Performance of french marigold (*Tagetes patula* L.) varieties with respect to duration of flowering (days) during *Rabi* 2021-22 and 2022-23.**

|  |
| --- |
| **Duration of flowering (days)** |
| **Treatments** | **2021-22** | **2022-23** | **Pooled** |
| **T1**: Bidan Kali Gainda  | 40.40 | 41.30 | 40.85 |
| **T2**: Pusa Arpita | 38.25 | 39.35 | 38.80 |
| **T3**: Pusa Deep  | 47.35 | 48.05 | 47.70 |
| **T4**: CGFM-1  | 46.18 | 46.70 | 46.44 |
| **T5**: Arka Pari | 46.40 | 47.25 | 46.83 |
| **SEm±** | 0.96 | 0.63 | 0.72 |
| **CD at 5 %** | 2.91 | 1.91 | 2.16 |

**Conclusion:**

Arka Pari was recorded as superior in terms of flowering attributes. The maximum flower weight was recorded in Pusa Arpita. Pusa Deep exhibited the largest flower diameter and the longest flowering duration. Arka Pari is recommended for pot cultivation due to its early flowering, medium-sized flowers, and maximum number of flower production.

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**ANOVA TABLES**

1. Number of days taken for first flower bud initiation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4 | 1243.91 | 310.98 | 447.48 | 3.06 | S |
| TOTAL | 19 | 1254.34 | 66.02 |  |  |  |
| ERROR | 15 | 10.42 | 0.69 |  |  |  |

2. Number of days taken for first flower bud opening

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 1507.06 | 376.76 | 670.10 | 3.06 | S |
| TOTAL | 19.00 | 1515.49 | 79.76 |  |  |  |
| ERROR | 15.00 | 8.43 | 0.56 |  |  |  |

3. Number of days taken for 50 percent flowering

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 1100.61 | 275.15 | 854.55 | 3.06 | S |
| TOTAL | 19.00 | 1105.44 | 58.18 |  |  |  |
| ERROR | 15.00 | 4.83 | 0.32 |  |  |  |

4. Number of days taken for full bloom

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 1097.97 | 274.49 | 623.61 | 3.06 | S |
| TOTAL | 19.00 | 1104.58 | 58.14 |  |  |  |
| ERROR | 15.00 | 6.60 | 0.44 |  |  |  |

5. Number of flowers per plant

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 1147.19 | 286.80 | 442.36 | 3.06 | S |
| TOTAL | 19.00 | 1156.91 | 60.89 |  |  |  |
| ERROR | 15.00 | 9.72 | 0.65 |  |  |  |

6. Number of flowers per pot

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 10406.89 | 2601.72 | 1477.41 | 3.06 | S |
| TOTAL | 19.00 | 10433.30 | 549.12 |  |  |  |
| ERROR | 15.00 | 26.42 | 1.76 |  |  |  |

7. Diameter of flower

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 266.22 | 66.55 | 55.04 | 3.06 | S |
| TOTAL | 19.00 | 284.36 | 14.97 |  |  |  |
| ERROR | 15.00 | 18.14 | 1.21 |  |  |  |

8.Weight of flower

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 5.62 | 1.41 | 7.76 | 3.06 | S |
| TOTAL | 19.00 | 8.34 | 0.44 |  |  |  |
| ERROR | 15.00 | 2.72 | 0.18 |  |  |  |

9. Duration of flowering

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOV | DF | SS | MSS | FCAL | FTAB | CONCLUSION |
| TREATMENT | 4.00 | 258.00 | 64.50 | 31.45 | 3.06 | S |
| TOTAL | 19.00 | 288.76 | 15.20 |  |  |  |
| ERROR | 15.00 | 30.76 | 2.05 |  |  |  |