## *Original Research Article*

## EFFECT OF TRANSPLANTING TIME AND SPACING ON GROWTH AND YIELD OF SUMMER AFRICAN MARIGOLD (*Tagetes erecta* L.) CV. PUNJAB GAINDA 1

**ABSTRACT**

Flowering behavior of floriculture crops influenced by many agro-techniques. Among them, proper time of transplanting and spacing directly affect the growth and yield. The current study used an RBD (factorial) design with two factors: Factor 1: Transplanting time (T), which is the second week of February (T1) and the fourth week of February (T2); Factor 2: Spacing (S), which is S1: 60 × 30, S2: 45 × 30 and S3: 30 × 30 cm. The purpose of this study was to assess the impact of transplanting time and spacing on the growth and yield of summer African marigold (*Tagetes erecta* L.) cv. Punjab Gainda 1. Treatments were repeated thrice. Experiment was conducted for two years i. e. 2020-21 & 2021-22. Result showed that 2nd week of February (T1)influenced growth and yield. Among different spacing, 60 × 30 cm (S1) improved growth and yield. However, 30 × 30 cm (S3) gave higher yield per hectare. Interaction effect of T1S1 recorded maximum number of flowers and flower yield per plant, whereas flower yield per hectare was observed with T1S3.

**Keywords:** African marigold, transplanting time, spacing, growth, flower yield

**1. INTRODUCTION**

African marigold (*Tagetes erecta* L.)popularly known as *Galgota* belongs to the family Asteraceae, is one of the hardiest annuals grown on variety of soils in different climatic conditions (Yadav *et al.,* 2024). Native to South and Central America, particularly Mexico, African marigold expanded to other regions of the world in the early 16th century (Kaplan, 1960). In landscaping, it is useful for filling up any open areas. Commercial applications include edging, bedding, religious offerings, flower baskets, garlands, floral decorations and potting (Swaroop *et al.,* 2007). Marigold flowers are readily available throughout the summer months, when no other flowers are readily available or reasonably priced. It is more resistant to drought, harsh temperatures and intense light than the majority of blooming plants. In several regions of the nation, it is grown all year round. Among different cultivars, Punjab Gainda 1 is open pollinated, heat tolerant, fully double, medium sized with orange-colored flowers suitable for flower production in summer season.

Despite the fact that flowers are grown nationwide, only a few states have major commercial flower cultivation. The development and flowering behaviors of marigold were greatly influenced by several agro-techniques, such as transplanting time, planting distance, pinching, weeding and fertilizer application, *etc.* Among them transplanting time and spacing have direct influences on the growth and yield of marigold.

Among other cultural requirements for proper growth and flowering of marigold, transplanting time is the most important factor which ensures the flower growth and yield (Jyothi *et al.,* 2018; Mohanty *et al.,* 2015 and Meena *et al*., 2015). Spacing directly controls the number of plants per unit area. The individual plant may receive enough space during wide planting for growth and development. In contrast, under closer spacing the plants do not get sufficient distance for their development, which results in a severe loss in production per unit area. This is because broader spacing results in higher production per unit of space planted (Singh *et al*., 2018). Therefore, spacing should be taken into account for mass production with high quality of flowers in African marigold.

Due to a lack of scientific research on the standardisation of horticultural practices under local agroclimatic conditions, the current study aims to determine the best time and spacing for planting marigold crops in order to maximise their performance and yield. The objectives are (i) To study the effect of transplanting time on the growth and yield attributes (ii) To study the effect of different spacing on the growth and yield attributes (iii) To find out the suitable combination of transplanting time and spacing for the growth and yield attributes of summer marigold

**2. MATERIALS AND METHODS**

**Experimental site**

In 2020-21 and 2021-22, an experiment was carried out at the Horticultural Research Farm, B. A. College of Agriculture, A.A.U., Anand, Gujarat. The location of the experiment was 22°35' North latitude and 72°56' East longitude, at an elevation of 45.1 meters above mean sea level. The middle Gujarat region has a semi-arid, subtropical climate. The months of October through May are typically sunny with an average of eight hours of sunshine per day. The end of February marks the start of hot weather, which lasts until the middle of June. Mid-October marks the start of winter, which lasts until the end of February. With an annual rainfall of 860 mm, the monsoon typically begins in the second two weeks of June and ends by the middle of September. The experimental site's soil was loamy sand or *"Goradu"* as it is known locally.

**Experimental design and treatments**

Three replications and a factorial principle were used in the RBD experimental design. FYM @ 15 t/ha and 200:100:100 NPK kg/ha were applied at the prescribed doses. FYM in its entirety, 50% N, 100% P and 100% K at the moment of transplantation and the remaining 50% N one month later. Every observation pertaining to marigold development and yield characteristics was documented.

Treatment details are as under:

**List 1 : Treatment details**

|  |
| --- |
| **Factor 1 – Transplanting time (T)** |
| 1. T1 - Second week of February |
| 2. T2 - Fourth week of February |
| **Factor 2 – Spacing (S)** |
| 1. S1 - 60 × 30 cm |
| 2. S2 - 45 × 30 cm |
| 3. S3 - 30 × 30 cm |

**3. RESULTS AND DISCUSSION**

**Growth parameters**

**Effect of transplanting time**

The transplanting time significantly influenced the growth of marigold plant (Table 1). The plant growth in terms of plant height (84.49 cm) was noted maximum with the treatment 2nd week of February (T1). It might be due to favorable growing conditions with average temperature, prevailing winds and environmental conditions such as photoperiod during the growth period of 2nd week of February planted crop may have resulted in better vegetative growth. These results were supported byDhakal *et al.* (2021), Mohanty *et al.* (2015) and Kusuma & Thaneshwari (2021) in marigold. However, transplanting time failed to exhibit any significant effect on number of branches per plant in pooled.

**Effect of spacing**

The growth of marigold plant was also significantly influenced due to plant spacings (Table 1). The differences in growth parameters due to spacing were found significant in case of plant height. Significantly higher plant height (84.47 cm) was recorded under the treatment S1 (60 × 30 cm) and it was at par with S2 (45 × 30 cm) i. e. 82.63 cm. This increase in growth characters might be due to the availability of more space which is due to the better growing environment and less competition for light, moisture and nutrients. Similar findings were also reported by Chaudhary *et al.* (2020) and Patel *et al.* (2023) in gaillardia. However, different spacing was failed to influence on number of branches.

 **Interaction effect of transplanting time and spacing**

The interaction effect (T × S) showed non-significant on growth parameters *viz*., plant height and number of branches per plant (Table 1).

**Table 1: Effect of transplanting time and spacing on plant height and number of branches per plant of marigold cv. Punjab Gainda 1 (Pooled of two years)**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Number of branches per plant** |
| **Factor 1: Transplanting time (T)** |
| T1: 2nd week of February  | 84.49 | 11.38 |
| T2: 4th week of February  | 79.39 | 10.88 |
| **S.Em.±** | 0.69 | 0.21 |
| **lsd0.05** | 2.00 | NS |
| **Factor 2: Spacing (S)** |
| S1:60 × 30 cm  | 84.47 | 11.63 |
| S2:45 × 30 cm  | 82.63 | 10.93 |
| S3:30 × 30 cm  | 78.72 | 10.85 |
| **S.Em.±** | 0.85 | 0.25 |
| **lsd0.05** | 2.44 | NS |
| **T × S** | NS | NS |
| **C. V. %** | 4.13 | 9.15 |

**Yield parameters**

**Effect of transplanting time**

In pooled data, yield parameters were significantly influenced due to different time of transplanting (Table 2). Minimum days taken for flower initiation (40.33) and days taken for 50% flowering (46.63) was recorded under the treatment T2(4th week of February), whereas, maximum flowering duration (76.58 days), flower diameter (5.31 cm), average weight of 10 flowers (51.21 g), shelf life (30.13 hrs), number of flowers per plant (44.42), flower yield per plant (199.96 g) and flower yield per hectare (14.95 t) recorded when transplanting was done during 2nd week of February (Table 2). Under favourable weather conditions, the crop transplanted during the second week of February may have produced higher vegetative growth components and more photosynthates moving from vegetative to reproductive portions. Dhakal *et al.* (2021) and Kusuma and Thaneshwari (2021) also noted this trend in marigold.

 **Table 2: Effect of transplanting time and spacing on yield parameters of marigold cv. Punjab Gainda 1 (Pooled of two years)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Days** **taken for flower initiation** | **Days taken for 50%** **flowering** | **Flowering duration (days)** | **Flower diameter (cm)** | **Av. weight of 10 flowers (g)** | **Shelf life (hours)** | **Number of flowers per plant** | **Flower yield per plant (g)** | **Flower yield (t/ha)** |
| **Factor 1: Transplanting time (T)** |
| T1: 2nd week of February | 46.08 | 53.75 | 76.58 | 5.31 | 51.21 | 30.13 | 44.42 | 199.96 | 14.95 |
| T2: 4th week of February | 40.33 | 46.63 | 71.21 | 4.80 | 47.79 | 24.75 | 36.04 | 154.98 | 11.76 |
| **S.Em.±** | 0.57 | 0.42 | 0.63 | 0.07 | 0.64 | 0.20 | 0.77 | 2.40 | 0.17 |
| **lsd0.05** | 1.63 | 1.21 | 1.82 | 0.20 | 1.86 | 0.56 | 2.22 | 6.94 | 0.49 |
| **Factor 2: Spacing (S)** |
| S1:60 × 30 cm | 44.00 | 51.00 | 74.56 | 5.28 | 50.88 | 28.44 | 47.69 | 223.07 | 12.39 |
| S2:45 × 30 cm | 43.50 | 50.06 | 73.69 | 5.07 | 50.25 | 27.25 | 39.69 | 180.76 | 13.39 |
| S3:30 × 30 cm | 42.13 | 49.50 | 73.44 | 4.82 | 47.38 | 26.63 | 33.31 | 128.59 | 14.29 |
| **S.Em.±** | 0.69 | 0.52 | 0.77 | 0.08 | 0.79 | 0.24 | 0.94 | 2.94 | 0.21 |
| **lsd0.05** | NS | NS | NS | 0.24 | 2.28 | 0.69 | 2.71 | 8.50 | 0.60 |
| **T × S** | NS | NS | NS | NS | NS | NS | Sig | Sig | Sig |
| **C. V. %** | 6.40 | 4.10 | 4.19 | 6.59 | 6.38 | 3.49 | 9.34 | 6.63 | 6.26 |

**Effect of spacing**

The seedlings transplanted at 60 × 30 cm (S1) showed maximum flower diameter (5.28 cm), average weight of 10 flowers (50.88 g), shelf life (28.44 days), number of flowers (47.69) and flower yield per plant (223.07 g). Days taken for flower initiation, days taken for 50% flowering and flowering duration was found non-significant due to different spacing (Table 2). Because there were more branches per plant and less competition for nutrients and light, the yield metrics were highest at wider spacing, and the weight of flowers per plant was directly connected with the number of flowers per plant. Similar results were also reported by Singh *et al.* (2018), Pal and Pandey (2007), Kumar *et al.* (2022), Chauhan *et al.* (2016) and Bhat & Shephered (2007) in marigold. However, treatment S3 (30 × 30 cm) had recorded significantly higher flower yield (14.29 t/ha). More plants per unit space could be the cause of this. Tiwari *et al.* (2010) similarly observed a similar outcome in marigold.

**Interaction effect of transplanting time and spacing**

In pooled, the interaction effect (T × S) was found non-significant for days taken for flower initiation, days taken for 50% flowering, flowering duration, flower diameter, average weightof 10 flowers and shelf-life. While, seedlings transplanted during 2nd week of February with spacing of 60 × 30 cm (T1S1) recorded significantly the highest number of flowers (53.88) and flower yield per plant (259.84 g) (Table 3). Perhaps this is because the seedlings transplanted at 60 × 30 cm during the second week of February offer ideal growing circumstances that promote the translocation of more photosynthates from vegetative to reproductive portions. The highest flower output per hectare (15.70 t) was reported by seedlings transplanted during the second week of February at 30 × 30 cm (T1S3). It could be because more plants were planted with closer spacing, which eventually raised the output per hectare.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Number of flowers per plant** | **Flower yield per plant (g)** | **Flower yield per hectare (t)** |
|  **S****T**  | **S1** | **S2** | **S3** | **S1** | **S2** | **S3** | **S1** | **S2** | **S3** |
| **T1** | 53.88 | 43.13 | 36.25 | 259.84 | 198.80 | 141.26 | 14.44 | 14.73 | 15.70 |
| **T2** | 41.50 | 36.25 | 30.38 | 186.30 | 162.72 | 115.93 | 10.35 | 12.05 | 12.88 |
| **S.Em.±** | 1.33 | 4.16 | 0.30 |
| **lsd0.05** | 3.84 | 12.02 | 0.85 |
| **C.V. %** | 9.34 | 6.63 | 6.26 |

**Table 3: Interaction effect of transplanting time and spacing on number of flowers per plant, flower yield per plant and flower yield per hectare of marigold cv. Punjab Gainda 1**

**4. CONCLUSION**

From the two years of field study, it can be concluded that for getting higher flower yield of African marigold cv. Punjab Gainda 1 during summer season, the seedlings should be transplanted in second week of February with spacing of 30 × 30 cm.

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