## *Short 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. Present study aimed to evaluate the effect of transplanting time and spacing on growth and yield of summer African marigold (*Tagetes erecta* L.) cv. Punjab Gainda 1 ~~using RBD (factorial) design comprising two factors~~ *~~i.e~~*~~., Factor 1:~~ Transplanting time (T) *viz*., Second week of February (T1) and Fourth week of February (T2~~); Factor 2:~~ Spacing (S) *viz*., S1: 60 × 30, S2: 45 × 30 and S3:30 × 30 cm. ~~Treatments were repeated thrice.~~ ~~Experiment was conducted for two years i. e. 2020-21 & 2021-22.~~ Result showed that ~~2~~~~nd~~week of February (T1) influenced ~~growth and yield~~. Among different spacing, 60× 30 cm (S1) improved ~~growth and yield~~. However,30×30 cm (S4) gave higher yield per hectare. Interaction effect of T1S1 ~~recorded~~ maximum number of flowers (value) 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. ~~African marigold~~ It is native to Central and South America especially ~~to~~ Mexico from where it spreads to different parts of the world during the early 16th century (Kaplan, 1960). It is commercially used for making garlands, floral decoration, flower baskets, religious offerings, potting, bedding, edgingand also for making different products. (Swaroop *et al.,* 2007). Availability of marigold flowers during summer months at that time no any other flowers are easy and economically available in the market. It can withstand high light intensities, high temperature and drought better than most of the flowering plants. It is grown throughout year in many parts of country. Among different cultivars, Punjab Gainda No. 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 influence~~s~~ on the growth, flowering and yield of marigold.Among other cultural requirements for proper growth, ~~and~~ flowering and yield 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 lack of scientific investigation under local agro-climatic condition on its standardization of horticultural practices, the present study is under taken to know the appropriate ~~planting~~ time and suitable spacing in which marigold crop performs well and provide better returns with ~~the objectives~~, (i) To study the effect of transplanting time and spacing on ~~the~~ growth, flowering and yield ~~attributes~~ of African marigold in summer season ~~(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**

An experiment on was conducted at Horticultural Research Farm, B.A. College of Agriculture, A.A.U., Anand, Gujarat during the year 2020-21 and 2021-22. It is situated geographically at 22o35' North latitude and 72o56' East longitude with an altitude of about 45.1 m above the mean sea level. The climate of middle Gujarat zone is semi-arid and subtropical type. October to May is sunny months generally receiving an average of eight hours sunshine per day. Temperature during hot weather commences by end of February and ends by about middle of June. Winter sets in the middle of October and continues till the end of February. Generally, monsoon starts from second fortnight of June and retreats by middle of September with an annual rainfall of 860 mm. The soil of the experimental site was loamy sand, locally known as *“Goradu”*

**Experimental design and treatments**

The experimental design was RBD with factorial concept with three replications. The recommended dose of FYM @ 15 t/ha and 200:100:100 NPK kg/ha were applied. Full dose of FYM along with 50% N, 100% P and K was applied at the time of and remaining 50% N at one month after transplanting. All observations regarding growth, flowering and yield parameters of marigold were recorded.

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 was noted maximum (84.49 cm) ~~with the treatment~~ 2nd week of February ~~(T~~~~1~~~~)~~. 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 by Dhakal *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 per plant.

**~~Interaction effect of transplanting time and spacing~~**

The interaction effect of transplating time and spacing (T × S) ~~showed~~ was found non-significant ~~on~~ in influencing various 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 African marigold cv. Punjab Gainda 1 (Pooled data 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 |

**Flowering and Yield parameters**

**~~Effect of transplanting time~~**

~~In pooled data,~~ All flowering and 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) was recorded when transplanting was done during 2nd week of February (Table 2). It might be due to the fact that the crop transplanted at 2nd week of February may have resulted in better vegetative growth components as well as translocation of more photosynthates from vegetative to reproductive parts under congenial climatic conditions. This trend was also reported by Kusuma and Thaneshwari (2021) and Dhakal *et al.* (2021) in marigold.

 **Table2: Effect of transplanting time and spacing on flowering and yield parameters of African 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). The ~~yield~~ parameters were observed maximum at wider spacing due to a greater number of branches per plant and also less competition among the plants for nutrients and light, while flowers weight per plant directly correlated with number of flowers per plants. 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 resulted in higher flower yield (14.29 t/ha) as compared to other treatments. This may be due to more number of plants per unit area . Similar result was also reported by Tiwari *et al.* (2010) 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 weight of 10 flowers and shelf-life. While, the highest number of flowers (53.88) and flower yield per plant (259.84 g) was recorded significantly in seedlings transplanted during 2nd week of February with spacing of 60 × 30 cm (T1S1) ~~recorded significantly~~ (Table 3). It might be due to the reason that the seedlings transplanted during ~~2~~~~nd~~ week of February at 60 × 30 cm spacing provided favorable growing conditions which enhanced translocation of more photosynthates from vegetative to reproductive parts. While, maximum flower yield per hectare (15.70 t) was recorded significantly from seedlings transplanted during 2nd week of February at 30 × 30 cm spacing (T1S3) ~~had recorded~~ ~~in pooled~~. It might be due to increased plant population under closer spacing which ultimately resulted in increased yield 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 |

**Table3: Interaction effect of transplanting time and spacing on number of flowers per plant, flower yield per plant and flower yield per hectare of African marigold cv. Punjab Gainda No. 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 No. 1 during summer season, the seedlings should be transplanted in second week of February with spacing of 30 × 30 cm.

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