# Effect of Organic Nutrients on Growth and Flowering Attributes of African Marigold *(Tagetes erecta* L.) under Terai Region of West Bengal


## ABSTRACT

A field experiment was conductedat Instructional farm, Department of Floriculture, Medicinal and Aromatic plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya during 2019-2020 to study the "Effect of organic nutrients on growth and flowering attributes of African Marigold (*Tagetes erecta* L.) under Terai region of West Bengal". The experiment was laid out by following Factorial Randomized Complete Block Design, consists of two factors in which first factor was varieties (Pusa Bahar-$V_1$ and Pusa Narangi Gainda- $V_2$) and second factor was ten treatments combination. Different Organic nutrients like Farm Yard Manure (FYM), Vermicompost, Poultry Manure, Sea Weed extract, Vermi wash and Mustard oil cake extract used in the experiments as basal application and foliar spray according to the treatments. The vegetative and floral attributes were recorded at peak flowering stage and the data was statistically analysed. The data was significantly differed among the varieties, treatments and different treatment combinations with varieties. Between the two varieties, var. Pusa Narangi Gainda ($V_2$) showed early flowering compared to var. Pusa Bahar ($V_1$) but the longer duration of flowering (49.41 days) was observed with the var. Pusa Bahar ($V_1$). Among the ten treatments, the treatment $T_{10}$ (Poultry Manure @ 2.5t/ha + Vermi wash @ 3%) resulted the best against the important flowering parameters like total number of flowers per plant (55.73) and weight of ten fresh flowers (103.08 g). The var. Pusa Narangi Gainda when treated with Poultry Manure @ 2.5t/ha + Vermi wash @ 3% ($T_{10}$)showed better performance in respect of several morphological and quality parameters of African Marigold. It may be recommended that the application of Poultry Manure@ 2.5t/ha as basal with combination of Vermi wash @3% spraying attwice (30 and 45 days after transplanting) during the plant growth for quantitative and qualitative producesof African Marigold in the terai region of West Bengal.



*Key words: African Marigold, Varieties, Organic Nutrient Sources*


## INTRODUCTION

African Marigold (*Tagetes erecta* L.) belongs to the family Asteraceae bearing chromosome 2n=24, which occupied an important place in Ornamental Horticulture. It is native of Central and Southern America especiallyin Mexico (Kaplan,1960) [1].African marigold is an annual, hardy and attains a height of 60-90 cm with crop duration of 3-4 months. African Marigold gained popularity among flower growersdue to its easy cultivation, and year-round demand of consumers. It is mainly grown for loose flower which are being used in making garland, festival occasion, poojas, marriage ceremony, social functions etc. African Marigold is suitable for landscaping, garden display, for bedding, as an herbaceous border and it is also ideal for newly planted shrubberies to provide multi colours display, rockeries, edging and window boxes. For ecofriendly cultivation and quality produces of marigold, it is essential to change the traditional cultivation techniques in which organic manures and chemical fertilizers used. Organic

farming is a holistic way of agriculture for conserving the soil physical and biological properties. It does not have any adverse effect on the ecosystem. Indian agriculture has a great opportunity to convert itself as organic cultivation by avoiding chemical fertilizers and pesticides in agriculture. Popularization of organic farming can effectively prevent the entry of pesticides and toxicants in the food chain and prevent soil and water pollution (Sreenivasa *et al*., 2009[2] and Natarajan, 2007) [3]. Hence, we are using various organic manures like FYM, Vermicompost, Poultry Manure, Sea Weed extracts as the sources of different nutrients. These are organic inputs can be applied in soil directly or we can spray to the standing crops also. Keeping these in view, the present investigation entitled "**Effect of organic nutrients on growth and flowering attributes of African marigold *(Tagetes erecta* L.) under Terai region of West Bengal".**

## MATERIALS AND METHODS

The present experiment was conducted at Instructional farm, Department of Floriculture, Medicinal and Aromatic plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya during 2019-2020. The experiment was laid out by following factorial Randomized Complete Block Design, consists of two varieties with ten treatments combination. The place is located in Terai Region of West Bengal at $26^0$ 19 N latitude and $89^0$ 23 E longitude. The site lies in the sub-Himalayan plains at an elevation of 43 metres above mean sea level. This zone is marked by a typical and sub-tropical climate with high relative humidity (86%), moderate temperature(8.30℃ – 31.00℃), rainfall (2 mm) during the period of experiment and prominent winter continues from September to March. The treatments of the experiment designed statistically as two factors Randomized Complete Block Design. The factors were varietal reaction with organic nutrient sources used as singly or in combination which are given in the table no.1. The varieties namely Pusa Bahar ($V_1$) and Pusa Narangi Gainda ($V_2$) collected from Indian Agricultural Research Institute (IARI), New Delhi.Different Organic nutrients used in the experiments like Farm Yard Manure (FYM), Vermicompost, Poultry Manure, Sea Weed extract, Vermi wash and Mustard oil cake extract have been collected from adjoining areas of the farm and reputed shops of the district of Cooch Behar, West Bengal. Land was ploughed and pulverized properly with the help of Power tiller. The different organic nutrient sources applied as basal and spraying on foliage as per the treatments. The basal dose of organic manures *viz.,*FYM, Vermi compost and Poultry manure were applied at the time of one week before transplanting of seedlings.

**Table No-1: The treatment details of the experiment**

| **First factor** | **Varieties** |
|---|---|
| **Notation** | **Name of the variety** |
| **$V_1$** | PusaBahar |
| **$V_2$** | PusaNarangiGainda |
| **Second factor** | **Organic manures application** |
| **Notation** | **Treatment details** |

| | |
|---|---|
| $T_1$ | Control (without organic and inorganic fertilizers) |
| $T_2$ | Farm yard manure (FYM) @ 30 t/ha and Sea weed Extract spray@3% |
| $T_3$ | Farm yard manure (FYM) @ 30 t/ha and Mustard oil Cake @ 3% |
| $T_4$ | Farm yard manure (FYM) @ 30 t/ha and Vermiwash@3% |
| $T_5$ | Vermi compost @5t/ha and Sea weed Extract spray@3% |
| $T_6$ | Vermi compost @5t/ha and Mustard oil Cake @ 3% |
| $T_7$ | Vermi compost @5t/ha and vermi wash @3% |
| $T_8$ | Poultry Manure@2.5t/ha and Sea weed Extract spray@3% |
| $T_9$ | Poultry Manure@2.5t/ha and Mustard oil Cake @ 3% |
| $T_{10}$ | Poultry Manure@2.5t/ha and vermi wash @3% |

Whereas other organic nutrient sourceslikefermented raw mustard oil cake and vermin wash (collected from vermi pit of the University) were diluted by water. Ten times dilution in volume with water was done for application as spray. The seedlings have been transplanted from nursery beds after 45 days from sowing. The seedlings transplanted in prepared plots (200 cm X 200 cm) with a spacing of 40 cm (row to row) X 40 cm (plant to plant). The planting was done at first week of November during morning hours and immediate after planting, light irrigation was applied to all the plots with the help of Rosecan. All the vegetative, floral and yield parameters were recorded at peak flowering stage according to the treatments.

## RESULTS AND DISCUSSION

The experimental results obtained from the present investigation as well as discussion have been summarized under followings heads:

### Effect of Organic manures on vegetative parameters

The vegetative parameters like plant height and plant spread have been taken and statistically analysed which represented in the Table no.2.The plant height and plant spread significantly differed among the varieties as well as among the treatments. In the table no-2, between the two varieties (firstfactor), the maximum plant height was recorded in var. Pusa Narangi Gainda (74.60 cm) and the lowest was found in var. Pusa Bahar (62.14 cm). The highest plant height was observed in $T_{10}$ (74.98 cm) and it was statistically at par with $T_7$ (74.12 cm), $T_8$ (73.09 cm) and $T_9$ (74.09 cm). The lowest plant height was observed in $T_1$ (63.28 cm) among the ten treatments. Plant spread both (E-W and N-S) was found more in var. Pusa Bahar (53.43 cm, 54.33 cm respectively) compared to Pusa Narangi Gainda (48.46 cm, 49.92 cm respectively). Plant spread (E-W) was found maximum in $T_{10}$ (59.82 cm) and it was found that $T_9$ (58.84cm) and $T_8$ (57.48cm) were statistically at par with the treatment $T_{10}$where asthe lowest in $T_1$ (45.25 cm). Plant spread (N-S) was found maximum in $T_8$ (67.09 cm) which is statistically at par with $T_9$ (65.16 cm) and $T_{10}$ (66.06 cm) and minimumplant spread was found in $T_1$ (45.25 cm) among the ten treatments.

The vegetative parameters like plant height and plant spread significantly differed among the

| Treatment details | Plant Height(cm) | Plant Spread(cm) | Days for first flower bud | Days for first flower full | Days for first flower wilting |
|---|---|---|---|---|---|

different treatment combinations. The data presented in the table No.2 showed that the maximum plant height (81.76 cm) was found in var. Pusa Narangi Gainda when treated with Poultry Manure@2.5t/haper hectare and in combination with vermi wash spraying @3% ($T_{10}$) and the minimum plant height was found in var. Pusa Bahar when treated without organic and inorganic fertilizers ($T_1$-Control). Plant spread {(E-W) (62.66 cm)} & {(N-S) (69.02 cm) respectively} was found maximum in var. Pusa Bahar ($V_1$)when treated with Poultry Manure@2.5t and in combination with vermi wash spraying @3% ($T_{10}$) and var. Pusa Narangi Gainda ($V_2$ ) when treated with Poultry Manure@2.5t/hectareand in combination with Sea weed Extract spraying@3%($T_8$)respectively whereas, the lowest Plant spread {(E-W) (42.21 cm)} & {(N-S) (43.46 cm)} was found in var. Pusa Narangi Gainda when treated without organic and inorganic fertilizers ($T_1$-Control)and in var. Pusa Bahar ($V_1$) when treated without organic and inorganic fertilizers ($T_1$-Control)respectively.

The plant height and plant spread were significantly influenced among the different treatment combinations as well as varieties. The vegetative attributes showed the best resultswhen application of poultry manures as basal followed by vermi wash spraying. It might be due to application of Poultry manure which is abundant source of major nutrients viz., NPK and other essential nutrients (Garg and Bahal, 2008) [4]. Nitrogen is the main constituent of chlorophyll, amino acids and protein which plays important role in cell division, protein synthesis and metabolite transport for building the plant tissues (Gupta and Prasad, 1991) [5]. Due to presence of higher amount of major essential nutrients and readily available form of nitrogen in uric acid and narrow C: N ratio than othernutrient facilitates increase in plant height, plant spread and number of leaves. The above findings were similar to the earlier study conducted by Malik *et al*., (2021) [6], Swathi et *al*., (2018) [7] in Marigold and Suseela *et al*., (2016) [8] in Tuberose.

The flowering parameters like days taken to first flower bud initiation, days taken for first flower full blooming and days taken to first flower wilting were have been taken and statistically analysed and represented in the Table no.2. These flowering parameters significantly differed among the varieties as well as among the treatments. In the table no.2 between the two varieties (first factor) the maximum days taken to first flower bud initiation (42.07 days), maximum days taken for first flower full blooming (13.71days) andmaximum days taken to first flower wilting (10.75 days) were found in the var. Pusa

| | | E-W | N-S | | | |
|---|---|---|---|---|---|---|
| **$V_1$** | 62.14 | 53.43 | 54.33 | 42.07 | 13.71 | 10.75 |
| **$V_2$** | 74.60 | 48.46 | 49.92 | 39.17 | 13.40 | 9.96 |
| **S. Em±** | 0.60 | 0.45 | 0.35 | 0.18 | 0.18 | 0.11 |
| **C.D. at 5%** | 1.705 | 1.276 | 0.993 | 0.524 | 0.527 | 0.313 |
| **Treatment details** | | | | | | |
| **$T_1$** | 63.28 | 45.64 | 45.25 | 46.37 | 16.62 | 7.78 |
| **$T_2$** | 69.86 | 51.89 | 53.94 | 38.43 | 12.15 | 10.97 |
| **$T_3$** | 68.13 | 51.44 | 54.40 | 39.07 | 13.70 | 10.38 |
| **$T_4$** | 69.93 | 52.92 | 53.51 | 39.43 | 14.00 | 10.77 |
| **$T_5$** | 68.92 | 55.82 | 55.52 | 41.13 | 9.63 | 13.30 |
| **$T_6$** | 71.03 | 54.96 | 55.25 | 41.83 | 10.70 | 13.23 |
| **$T_7$** | 74.12 | 56.03 | 56.93 | 41.17 | 10.67 | 13.60 |
| **$T_8$** | 73.09 | 57.48 | 67.09 | 40.30 | 12.83 | 10.40 |
| **$T_9$** | 74.08 | 58.84 | 65.16 | 40.33 | 12.62 | 11.07 |
| **$T_{10}$** | 74.98 | 59.82 | 66.06 | 40.53 | 13.13 | 10.67 |
| **S. Em±** | 1.33 | 1.00 | 0.78 | 0.41 | 0.41 | 0.24 |
| **C.D. at 5%** | 3.81 | 2.85 | 2.22 | 1.17 | 1.18 | 0.70 |
| **V (Variety) X T (Treatments)** | | | | | | |
| **$V_1 \times T_1$** | 55.10 | 49.06 | 47.03 | 47.07 | 16.13 | 8.13 |
| **$V_1 \times T_2$** | 62.68 | 52.27 | 54.60 | 41.67 | 12.13 | 11.27 |
| **$V_1 \times T_3$** | 63.35 | 53.53 | 56.59 | 40.40 | 15.33 | 10.37 |
| **$V_1 \times T_4$** | 62.79 | 55.07 | 56.27 | 40.80 | 15.73 | 10.20 |
| **$V_1 \times T_5$** | 66.68 | 57.23 | 57.15 | 40.40 | 9.20 | 13.80 |
| **$V_1 \times T_6$** | 68.52 | 57.01 | 56.14 | 41.47 | 9.50 | 13.53 |
| **$V_1 \times T_7$** | 67.87 | 53.99 | 57.15 | 41.33 | 8.93 | 13.67 |
| **$V_1 \times T_8$** | 67.45 | 59.76 | 65.17 | 39.67 | 12.40 | 10.33 |
| **$V_1 \times T_9$** | 69.27 | 61.24 | 65.50 | 39.00 | 11.10 | 11.93 |
| **$V_1 \times T_{10}$** | 68.19 | 62.66 | 66.63 | 39.53 | 12.47 | 11.47 |
| **$V_2 \times T_1$** | 71.39 | 42.21 | 43.46 | 45.67 | 17.10 | 7.43 |
| **$V_2 \times T_2$** | 77.05 | 51.51 | 53.27 | 35.20 | 12.17 | 10.67 |
| **$V_2 \times T_3$** | 72.90 | 49.35 | 52.20 | 37.73 | 12.07 | 10.40 |
| **$V_2 \times T_4$** | 77.07 | 50.77 | 50.74 | 38.07 | 12.27 | 11.33 |
| **$V_2 \times T_5$** | 71.16 | 54.42 | 53.88 | 41.87 | 10.07 | 12.80 |
| **$V_2 \times T_6$** | 73.55 | 52.90 | 54.35 | 42.20 | 11.90 | 12.93 |
| **$V_2 \times T_7$** | 80.37 | 58.07 | 56.70 | 41.00 | 12.40 | 13.53 |
| **$V_2 \times T_8$** | 78.74 | 55.20 | 69.02 | 40.93 | 13.27 | 10.47 |
| **$V_2 \times T_9$** | 78.89 | 56.45 | 64.81 | 41.67 | 14.13 | 10.20 |
| **$V_2 \times T_{10}$** | 81.76 | 56.97 | 65.49 | 41.53 | 13.80 | 9.87 |
| **S. Em±** | 1.88 | 1.41 | 1.10 | 0.58 | 0.58 | 0.35 |
| **C.D. at 5%** | 5.39 | 4.04 | 3.14 | 1.66 | 1.67 | 0.99 |

Bahar. The minimum days taken to first flower bud initiation (39.17 days), minimum days taken for first flower full

blooming (13.40 days) and minimum days taken to first flower wilting (9.96 days) were found in the var. Pusa Narangi Gainda. Among the ten treatments, $T_1$ (Control (without organic and inorganic fertilizers) recorded maximum days taken to first flower bud initiation (46.83 days), days taken for first flower full blooming (16.62 days) and $T_7$ (Vermi compost @5t/ha and vermi wash @3%) recorded maximum days taken to first flower wilting (13.60 days). while it was minimum (38.43 days) days taken to first flower bud initiation in $T_2$, minimum days taken for first flower full blooming (9.63 days) was found in $T_5$ and $T_1$(Control (without organic and inorganic fertilizers) recorded minimum days taken for first flower wilting (7.76 days).

The Flowering parameters significantly differed among the different treatment combinations. The maximum days taken to first flower bud initiation (47.07 days) was found in Pusa Bahar ($V_1$) when treated without organic and inorganic fertilizers ($T_1$-Control) and minimum days taken to first flower bud initiation (35.20 days) was recorded in var. Pusa Narangi Gainda ($V_2$) when treated with Farm yard manure (FYM) @ 30 t/ha in combination with Sea weed Extract spray@3% ($T_2$). The maximum days taken for first flower full blooming (17.10 days) was recorded in var. Pusa Narangi Gainda ($V_2$)when treated without organic and inorganic fertilizers ($T_1$-Control)and minimum days taken for first flower full blooming (8.93 days) recorded in var. Pusa Bahar ($V_1$)when treated with Vermi compost @5t/ha and in combination with vermi wash spraying @3% ($T_7$) whereas, maximum days taken to first flower wilting(13.67 days) was noticed in var. Pusa Bahar ($V_1$) when treated with Vermi compost @5t/ha and in combination with vermi wash spraying @3%( $T_7$). The minimum days taken to first flower wilting (7.43 days) was found in var. Pusa Narangi Gainda ($V_2$) when treated without organic and inorganic fertilizers ($T_1$-Control).

Plants treated with Farm Yard Manure (FYM) @ 30 t/ha + Sea Weed Extract spraying@ 3% recorded minimum days taken for first flower bud initiation. It may be due to amplification of nutrients mainly nitrogen, Phosphorous and potassium though FYM which paved the translocation of nutrients to phytohormones to the shoots resulting in early bud and flower initiation. Besides, increase in root density might be due to sea weed extract spray which promoted the more phosphorous absorption by roots and which helped in early bud initiation (Ali *et al* 2021) [9]. The above findings are in conformity with Singh and Vikas Kumar (2016) [10] in Marigold and Khanna *et al*., (2016) [11]in China aster.

Earliness in first flower full blooming may be due to supplementing nutrients (macro & micro), growth regulators and other enzymes by vermicompost which helped in better translocation of nutrients. This earliness also due to gibberellins in vermicompost, which are directly associated with regulation of flowering. The above findings are in corroborating with the Bordoloi and Madhumita Choudhury Talukdar (2019) [12] in Chrysanthemum.

The flowering parameters like duration of flowering, flower diameter, weight of ten fresh flowers, total number of flowers per plant and shelf life of flowershave been taken and statistically analysed and represented in the Table no.3. These flowering parameters significantly differed among the varieties as well as among the treatments. In the table no.3 between the two varieties (first factor). The duration of

flowering was recorded maximum (49.41 days) in the var. Pusa Bahar and minimum (49.35 days) was found in var. Pusa Narangi Gainda. The maximum flower diameter (5.94 cm) was recorded in var. Pusa Narangi Gainda and minimum flower diameter was found in var. Pusa Bahar (5.37 cm). The maximum weight of ten fresh flowers (91.79 g.), total number of flowers per plant (53.49) and highest shelf life of flower (5.38 days) was recorded in var. Pusa Narangi Gainda whereas, minimum weight of ten fresh flowers (88.78 g.), total number of flowers per plant (37.65) and highest shelf life of flower (5.23 days) was found in var. Pusa Bahar.

Among Ten different treatments the maximum duration of flowering (61.57 days) and flower diameter (6.18) was recorded in $T_7$ and $T_9$ respectively. The maximum weight of ten flowers (103.08 g.), number of flowers per plant (55.73) and shelf life (7.28 days) was recorded in $T_{10}$ and $T_6$ respectively. It was found that duration of flowering (43.20 days), flower diameter (4.64 cm), weight of ten flowers (82.08 g.), number of flowers per plant (35.60) and shelf life (3.87 days) was found minimum in $T_1$. The Flowering parameters significantly differed among the different treatment combinations. The data presented in Table No.-3 (Fig No.-1) revealed that duration of flowering (61.90 days) and flower diameter (6.63 cm) was found maximum in var. Pusa Bahar ($V_1$) when treated with Vermi compost @5t/ha and in combination with vermi wash spraying @3% ($T_7$)and in var. Pusa Narangi Gainda ($V_2$)treated with Vermi compost @5t/ha and in combination with Mustard oil Cake spraying @ 3%($T_6$) respectively whereas, it was found duration of flowering (38.27 days) and flower diameter (4.51 cm) was found minimum in var. Pusa Bahar ($V_1$) when treated without organic and inorganic fertilizers ($T_1$-Control). The maximum weight of ten fresh flowers (116.67 g.) was found in var. Pusa Narangi Gainda($V_2$) when treated with Vermi compost @5t/ha and in combination with vermi wash spraying @3% ($T_7$) and minimum weight of ten fresh flowers (80.50 g.) observed invar Pusa Bahar ($V_1$) when treated without organic and inorganic fertilizers ($T_1$-Control). Number of flowers per plant (63.27) and shelf life (8.60 days) was recorded highest in var. Pusa Narangi Gainda ($V_2$) when treated with Poultry Manure@2.5t and in combination with vermi wash spraying @3% ($T_{10}$) whereas, it was minimum in var Pusa Bahar ($V_1$) when treated without organic and inorganic fertilizers ($T_1$-Control).

The duration of flowering which deals for availability of flowers for longtime, is an important factor for more return from per unit area. Increase in duration of flowering might be due to mobilization of nutrients, increase in synthesis of proteins and degradation of chlorophyll prevention due to sufficient amount of nutrients supplied by the vermicompost and vermi wash. This finding is in conformity with Kumar *et al.,* 2020 [13], Kumar and Vishwanath (2020) [14], Mittal *et al*., (2010) [15] in Marigold, Bordoloi and Madhumita Choudhury Talukdar (2019) in Chrysanthemum [12], Pandy *et al*. [16], (2017) in Dhalia. Application of Poultry manure@ 2.5t/ha in combination with Fermented Mustard oil Cake spraying @ 3% increased the flower diameter due to availability of sufficient macro and micro nutrients supplied by poultry manure which ultimately resulted in vigorous growth of plants. Increase in phosphorous is found to be responsible for the initiation of floral primordial formation resulting in the increase in flower diameter. The above finding is in conformity with Bohra *et al.,* 2014[16] in chrysanthemum.

**Fig.-1: Effect of different organic nutrient sources on flowering duration of African marigold.**

**Fig.-2: Effect of different organic nutrient sources on total number of flowers per plant of African marigold**

*Figure 3 : Effect of organic nutrient sources on floral and yield attributes of African Marigold*

| Treatment details | Flowering duration(days) | Flower diameter(cm) | Weight of 10 fresh flowers (g) | Total number of flowers per plant | Shelf life of loose flower(days) |
|---|---|---|---|---|---|
| $V_1$ | 49.41 | 5.37 | 88.78 | 37.65 | 5.23 |
| $V_2$ | 49.35 | 5.94 | 91.79 | 53.49 | 5.38 |
| S. Em± | 0.17 | 0.04 | 1.16 | 1.17 | 0.09 |
| C.D. at 5% | 0.478 | 0.127 | 3.313 | 3.363 | 0.268 |
| **Treatment details** | | | | | |
| $T_1$ | 43.20 | 4.64 | 82.08 | 35.60 | 3.87 |
| $T_2$ | 49.00 | 5.83 | 88.50 | 49.97 | 5.63 |
| $T_3$ | 49.80 | 6.05 | 96.78 | 46.73 | 5.88 |
| $T_4$ | 50.57 | 5.87 | 90.42 | 48.70 | 5.65 |
| $T_5$ | 59.57 | 6.13 | 90.50 | 47.93 | 6.67 |
| $T_6$ | 61.23 | 6.04 | 88.17 | 54.23 | 7.28 |
| $T_7$ | 61.57 | 5.94 | 98.71 | 48.63 | 6.80 |
| $T_8$ | 55.23 | 5.97 | 95.38 | 50.50 | 5.78 |
| $T_9$ | 52.67 | 6.18 | 100.21 | 49.93 | 5.83 |
| $T_{10}$ | 52.50 | 5.94 | 103.08 | 55.73 | 5.78 |
| S. Em± | 0.37 | 0.10 | 2.59 | 2.63 | 0.21 |
| C.D. at 5% | 1.07 | 0.28 | 7.41 | 7.52 | 0.60 |
| **V (Variety) X T (Treatments)** | | | | | |
| $V_1 \times T_1$ | 38.27 | 4.51 | 80.50 | 33.67 | 4.20 |
| $V_1 \times T_2$ | 48.40 | 5.35 | 86.50 | 50.00 | 5.20 |
| $V_1 \times T_3$ | 49.87 | 5.71 | 93.88 | 38.27 | 5.57 |
| $V_1 \times T_4$ | 51.20 | 5.45 | 87.50 | 42.00 | 5.57 |
| $V_1 \times T_5$ | 59.33 | 5.84 | 95.50 | 39.80 | 5.60 |
| $V_1 \times T_6$ | 61.40 | 5.45 | 85.00 | 47.73 | 5.97 |
| $V_1 \times T_7$ | 61.93 | 5.39 | 80.75 | 47.33 | 5.73 |
| $V_1 \times T_8$ | 57.07 | 5.55 | 85.25 | 51.40 | 6.23 |
| $V_1 \times T_9$ | 53.33 | 5.77 | 99.75 | 51.07 | 6.07 |
| $V_1 \times T_{10}$ | 52.07 | 5.85 | 104.33 | 61.47 | 6.10 |
| $V_2 \times T_1$ | 48.13 | 4.77 | 83.67 | 37.53 | 3.53 |
| $V_2 \times T_2$ | 49.60 | 6.31 | 90.50 | 36.67 | 6.07 |
| $V_2 \times T_3$ | 49.73 | 6.39 | 99.67 | 55.20 | 6.20 |
| $V_2 \times T_4$ | 49.93 | 6.29 | 93.33 | 55.40 | 5.73 |
| $V_2 \times T_5$ | 59.80 | 6.41 | 85.50 | 56.07 | 7.73 |
| $V_2 \times T_6$ | 61.07 | 6.63 | 91.33 | 60.73 | 5.47 |
| $V_2 \times T_7$ | 61.20 | 6.48 | 116.67 | 49.93 | 7.87 |
| $V_2 \times T_8$ | 53.40 | 6.38 | 105.50 | 49.60 | 5.33 |
| $V_2 \times T_9$ | 52.00 | 6.59 | 100.67 | 48.80 | 5.60 |

| | | | | | |
|---|---|---|---|---|---|
| **$V_2$ x $T_{10}$** | 52.93 | 6.02 | 101.83 | 63.27 | 8.60 |
| **S. Em±** | 0.53 | 0.14 | 3.66 | 3.71 | 0.30 |
| **C.D. at 5%** | 1.51 | 0.40 | 10.48 | 10.63 | 0.85 |

Plants treated with Vermicompost @ 5t/ha + Vermiwash @ 3% showed increased weight of flowers. It may be due to presence of existent growth promoting substances like essential lant nutrients, enzymes vitamins, and antibiotics in vermicompost and vermiwash. Present findings are in similar with reported by Kumar and Vishwanath (2020) [14], Sudhagar *et al*., (2019) [18] in African marigold and Bohra *et al*., (2014) [17]

The data presented in Table No.-3 (Fig No.-1) revealed that Poultry Manure@ 2.5t/ha + Vermiwash @ 3% application showed highest number of flowers per plant and shelf life of flowers. The maximum flower production could be due to poultry manure which increased the water holding capacity of soil by improving soil texture, also improves humus status of soil. It also helps in improving physico chemical properties of the soil viz., pH, EC, organic carbon, macro and micro nutrients. It may be due vermiwash which contains all secondary, macro, micro nutrients and presence of ethylene inhibitors or due to cytokinins may also enhanced the uptake of Ca and Mg. Similar result were also reported by Garge *et al*., (2020) [4], Parya *et al.,* (2017) [19], Mittal *et al*., (2010) [15] and Bohra *et al*., (2014) [17].

## CONCLUSION

Based on the result of the present study It may be recommended that the application of Poultry Manure @ 2.5t/ha as basal with combination of Vermi wash @3% spraying at twice (30 and 45 days after transplanting) during the plant growth for quantitative and qualitative produces of African Marigold in the Terai Region of West Bengal.

## COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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