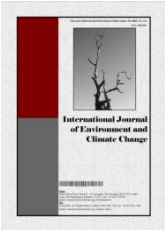

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Effect of Organic Nutrients on Growth and Flowering Attributes of African Marigold *(Tagetes erecta* L.) under Terai Region of West Bengal

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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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" with the objectives of different organic inputs for production of quantitative and qualitative flowers of African Marigold. Now a day's organic cultivation practices have immense potentiality due to huge demand as because it resulted low health hazards as well as gave pollution free environment and improved soil fertility. 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

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statisticallyanalysed. 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 + Vermiwash @ 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 + Vermiwash @ 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.

Keywords: African marigold; varieties; organic nutrient sources.

1. 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 [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. Forecofriendly 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 [2,3]. 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".

2. 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 and the data of different attributes have been statistically calculated by following Gomez and Gomez [4], the biometrical parameters of data collected throughout the investigation period were calculated statistically by using OPSTAT. The analyzed results of the parameters have been displayed at a 5% probability level. 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 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, Vermiwash 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 such as FYM, Vermi compost and Poultry manure were applied at the time of one week before transplanting of seedlings.

Whereas other organic nutrient sources like fermented 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.

3. RESULTS AND DISCUSSION

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

3.1 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 2. The plant height and plant spread significantly differed among the varieties as well as among the treatments. In the Table 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 different treatment combinations. The data presented in the Table 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/ha 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 [5]. 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 [6]. 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., [7], Swathi et al. [8] in Marigold and Suseela et al. [9] in Tuberose.

Table 1. The treatment details of the experiment

First factor	Varieties
Notation	**Name of the variety**
V_1	Pusa Bahar
V_2	Pusa Narangi Gainda
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%

Table 2. Effect of organic nutrient sources on vegetative and floral attributes of African Marigold

Treatment details	Plant Height(cm)	Plant Spread(cm)		Days for first flower bud initiation (days)	Days for first flower full blooming (days)	Days for first flower wilting (days)
		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 x T_1	55.10	49.06	47.03	47.07	16.13	8.13
V_1 x T_2	62.68	52.27	54.60	41.67	12.13	11.27
V_1 x T_3	63.35	53.53	56.59	40.40	15.33	10.37
V_1 x T_4	62.79	55.07	56.27	40.80	15.73	10.20
V_1 x T_5	66.68	57.23	57.15	40.40	9.20	13.80
V_1 x T_6	68.52	57.01	56.14	41.47	9.50	13.53
V_1 x T_7	67.87	53.99	57.15	41.33	8.93	13.67
V_1 x T_8	67.45	59.76	65.17	39.67	12.40	10.33
V_1 x T_9	69.27	61.24	65.50	39.00	11.10	11.93
V_1 x T_{10}	68.19	62.66	66.63	39.53	12.47	11.47
V_2 x T_1	71.39	42.21	43.46	45.67	17.10	7.43
V_2 x T_2	77.05	51.51	53.27	35.20	12.17	10.67
V_2 x T_3	72.90	49.35	52.20	37.73	12.07	10.40
V_2 x T_4	77.07	50.77	50.74	38.07	12.27	11.33
V_2 x T_5	71.16	54.42	53.88	41.87	10.07	12.80
V_2 x T_6	73.55	52.90	54.35	42.20	11.90	12.93
V_2 x T_7	80.37	58.07	56.70	41.00	12.40	13.53
V_2 x T_8	78.74	55.20	69.02	40.93	13.27	10.47
V_2 x T_9	78.89	56.45	64.81	41.67	14.13	10.20
V_2 x 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

Table 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

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_2 x T_4	49.93	6.29	93.33	55.40	5.73
V_2 x T_5	59.80	6.41	85.50	56.07	7.73
V_2 x T_6	61.07	6.63	91.33	60.73	5.47
V_2 x T_7	61.20	6.48	116.67	49.93	7.87
V_2 x T_8	53.40	6.38	105.50	49.60	5.33
V_2 x 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$\pm$	0.53	0.14	3.66	3.71	0.30
C.D. at 5%	1.51	0.40	10.48	10.63	0.85

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 2. These flowering parameters significantly differed among the varieties as well as among the treatments. In the Table 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 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 (9.63days) 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 9]. The above findings are in conformity with Singh and Vikas Kumar [11] in Marigold and Khanna et al., [12] 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 [13] 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 3. These flowering parameters significantly differed among the varieties as well as among the treatments. In the Table 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 treatmentsthe 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 3 (Fig. 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. PusaBahar (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/ha 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 vermiwash. This finding is in conformity with Kumar et al., [14], Kumar and Vishwanath [15], Mittal et al., [16] in Marigold, Bordoloi and Madhumita Choudhury Talukdar in Chrysanthemum [13], Pandey et al. [17], (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., [18] in chrysanthemum.

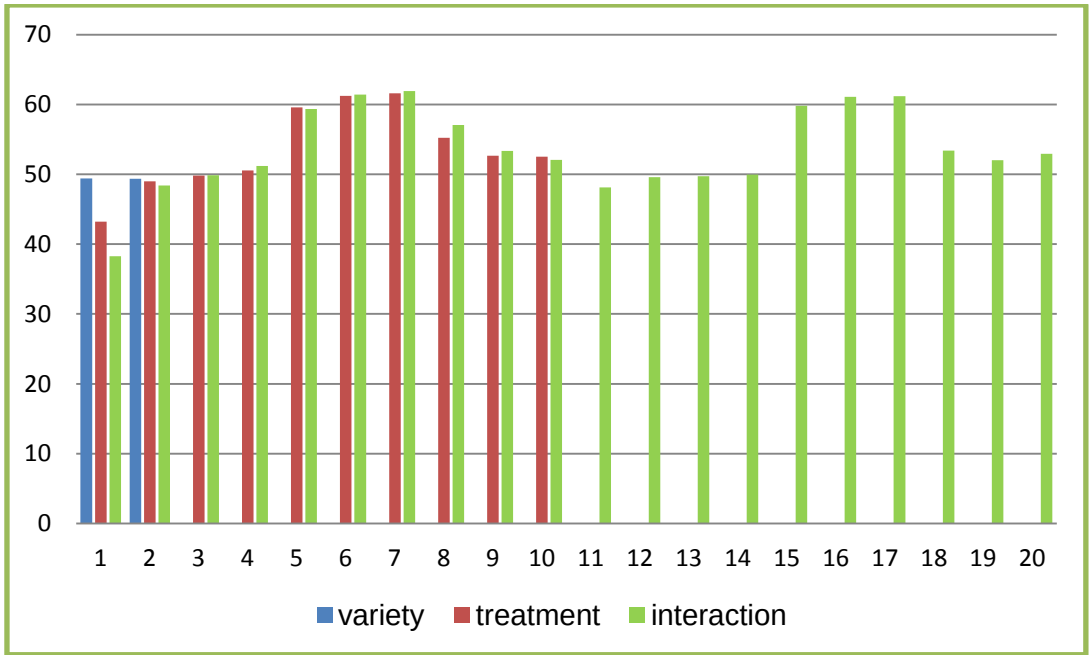

Fig. 1. Effect of different organic nutrient sources on flowering duration of African marigold

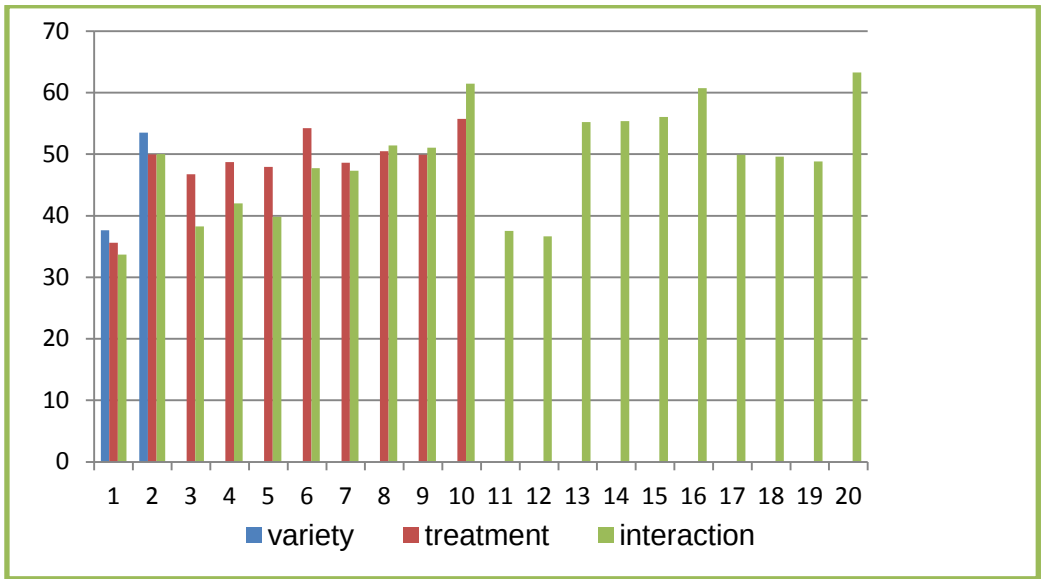

Fig. 2. Effect of different organic nutrient sources on total number of flowers per plant of African marigold

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 plant nutrients, enzymes vitamins, and antibiotics in vermicompost and vermiwash. Present findings are in similar with reported by Kumar and Vishwanath [15], Sudhagar et al. [19] in African marigold and Bohra et al. [18].

The data presented in Table 3 (Fig. 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 Garg et al. [5], Parya et al. [20], Mittal et al. [16] and Bohra et al. [18].

4. 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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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