



EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON FLOWERING CHARACTERS OF AFRICAN MARIGOLD (*TAGETES ERECTA* L)

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Abstract- An Integrated Nutrient Management System (INMS) may play a vital role in sustaining both soil health and crop production on a long term basis, which may be achieved through the combined use of all possible sources of nutrition. The present investigation was carried out during *Kharif* season of 2009-2010 with 16 treatments in RBD replicated 2 times. The results shown that 50% RDF and rest through poultry Manure gave a significant increase in flowering characters i.e. flower bud initiation (41.17), 50% flowering (66.60), duration of flowering (60.59), No. Of flower/plant (9.97) and ultimately produce a significantly higher flower yield /plot (26.86) and per hectare (370.69 q/ha).

Keywords- Flower initiation, Marigold, Flower yield, 50% flowering.

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Introduction

Marigold gained popularity amongst gardeners and flower dealers on account of its easy culture and wide adaptability. Its habit of free flowering, short duration to produce marketable flowers, wide spectrum of attractive colour, shape, size and good keeping quality attracted the attention of flower growers. It is highly suitable as bedding plants, in herbaceous borders and also ideal for newly planted shrubberies to provide colour and fill the space.

The area under flower production in India is around 255 thousand ha with a production of 2297 thousand MT of loose flowers and 543 lakh numbers of cut flowers [1]. In MP flowers are grown in an area of 17.1 thousand ha with an annual production of 200.4 thousand MT [1]. Marigold is grown on small farms all over the country under open field conditions, for centuries. Very few varieties have been developed for this crop and location specific package of practices is still not available. Marigold is grown in many districts of Madhya Pradesh. During, Ganesh utsav Durga pooja, Deepawali and other similar religious functions the price of marigold is usually high ranging from Rs. 8-15 per kilogram.

However, complete organic farming is possible only in subsistence farming and is not possible in commercial floriculture, where the yield of produce is as important as the quality of produce. Also, it is difficult to meet the requirement of nutrients for the crops exclusively through organic sources. In addition, the unavailability of organic matter in such huge quantities is also a constraint. Thus, the necessity to get sustainable flower production calls for an integrated approach of nutrient management.

An Integrated Nutrient Management System (INMS) may play a vital role in sustaining both soil health and crop production on a long term basis, which may be achieved through the combined use of all possible sources of nutrition. Keeping in view the above cited aspects, the present investigation was carried out to develop suitable INM practices in African Marigold cv. Pusa Narangi and Pusa Basanti for improve flowering characters.

Materials and Methods

The present investigation was carried out during *Kharif* season of 2009-2010 at

Bahaduri farm, K.N.K. College of Horticulture, Mandsaur (M.P.). Mandsaur is situated in the Malwa plateau in the western part of M.P. at north latitude of 23.45° to 24.13° and 74.44° to 75.18° East longitude and an altitude of 435.20 meters above mean sea level. The average annual rainfall is 544.05 mm. The soil of experimental field was light black loamy in texture, with low availability of nitrogen, medium in phosphorus and low in potassium status. The experiment was laid out in Factorial Randomized Block Design (FRBD) comprises 16 treatments (8 INM combination and 2 Varieties) replicated 3 times. The treatments were T₁: RDF @ 80:40:40 kg/ha (control), T₂: 50% RDF + 50% RDN through FYM, T₃: 50% RDF + 50% RDN through Vermicompost, T₄: 50% RDF + 50% RDN through Poultry manure, T₅: 50% RDF + 50% RDN through WellGro soil (Commercial formulation), T₆: 100% RDF + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium*, T₇: 50% RDF + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium*, and T₈: 100% RDN by Vermicompost + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium*. The seeds were sown on 30th June 2009.

After executing the plan of the layout, the calculated quantities of manures and fertilizers were applied to the respective plots. All the well decomposed manures were applied in furrows immediately before transplanting of the seedlings. The sources of nitrogen, phosphorus and potash were urea (46% N), single super phosphate (16% P₂O₅) and muriate of potash (60% K₂O), respectively. The half dose of nitrogen with full doses of P₂O₅ and K₂O were applied as basal, at the time of transplanting. The remaining dose of N was top dressed at 35 days of transplanting (DAT).

Results and Discussion

Flower bud Initiation:

Data recorded in the present study indicated that variety V₁ (Pusa Basanti) recorded higher mean value for a number of days to flower bud initiation than the variety V₂ (Pusa Narangi). Among the INM treatments the lowest number of days to flower bud initiation was recorded by treatment combination T₄ (50% RDF + 50% RDN Poultry Manure) while the highest value was recorded in T₁ (RDF-control). Considering the interaction effect, in a variety V₁ the treatment combination V₁T₂

(50% RDF + 50% RDN Vermi compost) recorded a lowest mean number of days to flower bud initiation while the highest was recorded by V₁T₁ (control). Similarly, in a variety V₂ the treatment combination V₂T₄ (50% RDF + 50 RDN % Poultry Manure) recorded the lowest number of days to flower bud initiation while the highest number of days to flower bud initiation was recorded in V₂T₁ (control).

The highest early flowering in Variety V₁ (Pusa Basanti) by the treatment combination 50% RDF + 50% RDN FYM might be due to the fact that the application of FYM might be attributed to good physical and biological conditions of soils which might have improved the physiology of plant to shift from vegetative to reproductive stage. The present results are supported by the findings of Gaur *et al.*, (2008) [2] in African marigold, Patil *et al.*, (2008)[3] in China aster, Singh and Kumar, (2008)[4] in Rose and Verma and Thomas, (2009)[5] in Carnation. The earlier flower bud initiation in variety V₂ (Pusa Narangi) by the treatment T₄ (50% RDF + 50 % RDN Poultry Manure) Moreover, higher content of nitrogen might have accelerated protein synthesis, thus promoting earlier floral primordial development. Thus, results are in conformity with the findings of Acharya and Dashora (2004)[6] in African marigold. The increase in phosphorus is also found to be involved in the initiation of flower primordial formation leading to increase in size and number of flowers in African marigold. These results are in close agreement with the findings of Dahiya *et al.* (1998)[7] in marigold.

Days to 50% flowering:

Variety V₂ (Pusa Narangi) recorded a lower mean number of days to 50 percent flowering than the variety V₁ (Pusa Basanti) which recorded a highest value. Among the INM treatments the lowest mean number of days to 50 percent flowering was recorded by treatment combination T₄ (50% RDF + 50 % RDN Poultry Manure) while the control showed the highest number of day's required for 50 percent flowering.

The earlier 50% flowering by the treatment T₄ (50% RDF + 50 % RDN Poultry Manure) might be due to the fact that Poultry manure contains all macro and micro nutrients and also improves physiochemical and biological properties of soil, which enables the plant to proliferate resulting better utilization of nutrients by crop plants. The present results are supported by the findings of Naik *et al.*, (2008)[3] in African marigold and Verma and Thomas, (2009)[5] in Carnation.

Duration of flowering:

Variety V₂ (Pusa Narangi) recorded a longer duration of flowering than the variety V₁ (Pusa Basanti). Among the INM treatments the longest duration of flowering was recorded by T₄ (50% RDF + 50% RDN Poultry Manure) while the control showed the lowest number of day's required for duration of flowering.

The longest duration of flowering by the treatment T₄ (50% RDF + 50 % RDN Poultry Manure) The increase in flowering duration can be attributed to increased protein synthesis, rapid nutrient mobilization and prevention of chlorophyll degradation due to sufficient amounts of nutrient availability in VAM + vermicompost enriched soils. These results are in agreement with the findings of Chopde *et al.* (2007)[8] in tuberose and Dalve *et al.* (2009)[9] in gladiolus.

Numbers of flowers per plant:

Variety V₁ i.e. cv. Pusa Basanti recorded a lower mean number of flowers per plant than the variety V₂ i.e. cv. Pusa Narangi. Among the INM treatments, highest number of flowers per plant were recorded by T₄ (50% RDF + 50 % RDN Poultry Manure) while the control showed a lowest fresh weight of flowers. Considering interaction effect, In V₁ i.e. cv. Pusa Basanti the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded the highest mean number of flowers per plant while the lowest number of flowers per plant was recorded in V₁T₁ (control). Similarly in V₂ i.e. cv. Pusa Narangi the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest number of flowers per plant while the lowest number of flowers was recorded in V₂T₁ (control).

In V₁ (Pusa Basanti) the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded the highest mean number of flowers per plant this might be due to the fact that the application of FYM might be attributed to good physical and biological conditions of soils which might have improved the physiology of plant to shift from vegetative to reproductive stage. The present results are

supported by the findings of Sreenivas *et al.* (1999)[10] in China aster, Mishra (1998)[11] in *Gaillardia pulchella*, Jana and Pal (1991)[12] in *Cosmos sulphureus* and Subrata *et al.* (1998)[13] in China aster. Similarly, in V₂ (Pusa Narangi) the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest number of flowers per plant this might be due to, among the organic sources, application of N in the form of poultry manure improved the quality parameters. Poultry manure contains all the essential nutrients (both macro and micronutrients), which are necessary for improving quality. The beneficial effect of vermi-compost, poultry manure and FYM are in close conformity with those of Arancon *et al.* (2003)[14] and Sharma *et al.* (2004)[15].

Flower yield per plot:

Variety V₁ (Pusa Basanti) recorded a lower mean flower yield per plot than the variety V₂ (Pusa Narangi). Among the INM treatments, highest flower yield per plot was recorded by T₄ (50% RDF + 50 % RDN Poultry Manure) while the control showed lowest mean flower yield per plot. Considering the interaction effect, in variety V₁ (Pusa Basanti) the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded a highest mean flower yield per plot (25.93 kg) while the lowest flower yield per plot was recorded in V₁T₁ (control). Similarly, in variety V₂ (Pusa Narangi) the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest flower yield per plot while the lowest flower yield per plot was recorded in V₂T₁ (control).

In variety V₁ (Pusa Basanti) the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded a highest mean flower yield per plot this might be due to increase in number of flowers per plant and fresh weight of flowers per plant by the application of FYM. The present findings are supported by Sreenivas *et al.* (1999)[10] in China aster, Mishra (1998)[11] in *Gaillardia pulchella*, Jana and Pal (1991)[12] in *Cosmos sulphureus* and Subrata *et al.* (1998)[13] in China aster. Similarly, in variety V₂ (Pusa Narangi) the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest flower yield per plot, this might be due to increase in number of flowers per plant and fresh weight of flowers per plant. Poultry manure provided adequate nutrient availability and improved physical and chemical condition of the soil and increased population of microorganisms and their activities, which gave synchronized effect and enhanced yield of flowers than the other alternative source. These improved yield parameters may be due to nutrition effect and improved soil physical environment Prakash *et al.* (2002)[16].

Flower yield per hectare:

Variety V₁ (Pusa Basanti) recorded a lower mean flower yield per hectare than the variety V₂ (Pusa Narangi). Among the INM treatments, the highest flower yield per hectare was recorded by T₄ (50% RDF + 50 % RDN Poultry Manure) while the control showed the lowest flower yield per hectare. Considering the interaction effect, in variety V₁ (Pusa Basanti) the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded the highest mean flower yield per hectare while the lowest flower yield per hectare was recorded in V₁T₁ (control). Similarly, in variety V₂ (Pusa Narangi) the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest flower yield per hectare while the lowest flower yield per hectare was recorded in V₂T₁ (control).

In variety V₁ (Pusa Basanti) the treatment combination V₁T₂ (50% RDF + 50% RDN Vermi compost) recorded the highest mean flower yield per hectare. This might be due to increase in number of flowers per plant and fresh weight of flowers per plant by the application of FYM. The present findings are supported by Sreenivas *et al.* (1999)[10] in China aster, Mishra (1998)[11] in *Gaillardia pulchella*, Jana and Pal (1991)[12] in *Cosmos sulphureus* and Subrata *et al.* (1998)[13] in China aster. Similarly, in variety V₂ (Pusa Narangi) the treatment combination V₂T₄ (50% RDF + 50 % RDN Poultry Manure) recorded the highest flower yield per hectare, which might be due to increase in number of flowers per plant and fresh weight of flowers per plant by the application of poultry Manure Naik *et al.*, (2008)[3] in African marigold, Singh and Kumar, (2008)[4] in Rose and Verma and Thomas, (2009)[5] in China aster.

Table-1 Flowering characters of Marigold as influenced by INM Treatments

Treatments	Flower bud Initiation			50% flowering			Duration of flowering		
	V ₁	V ₂	Mean	V ₁	V ₂	V ₁	V ₁	V ₂	Mean
T1- RDF (Control)	62.33	51.33	56.83	46.53	46.53	46.53	37.30	49.99	43.65
T2- 50% RDF + 50%FYM	42.67	45.67	44.17	69.23	69.23	69.23	56.10	59.22	57.66
T3-50% RDF + 50%VC	55.33	40.33	47.83	60.17	60.17	60.17	46.59	64.81	55.7
T4-50% RDF+ 50%PM	44.00	38.33	41.17	66.60	66.60	66.60	54.04	67.14	60.59
T5-50% RDF + 50%WG	57.33	46.33	51.83	57.16	57.16	57.16	42.42	57.32	49.87
T6-100% RDF + 100% BF	59.00	47.33	53.17	53.42	53.42	53.42	39.37	56.59	47.98
T7-100% RDF + 100% BF	60.33	48.67	54.5	49.33	49.33	49.33	38.45	55.31	46.88
T8-100% VC + 100% BF	45.67	42.67	44.17	63.36	63.36	63.36	51.01	60.24	55.63
Mean	53.33	45.08		58.22	58.22	58.22	45.66	58.83	
	V	T	V x T	V	V	V	V	T	V x T
S.Em±	0.893	1.787	2.53	0.827	0.827	0.827	1.876	3.753	5.31
CD at 5%	2.580	5.161	7.30	2.388	2.388	2.388	5.419	10.839	N.S.

Table-2 Flowering yield of Marigold as influenced by INM

Treatments	No. of Flowers/ Plant			Flower Yield/ Plot			Flower Yield/ ha		
	V ₁	V ₂	Mean	V ₁	V ₂	Mean	V ₁	V ₂	Mean
T1- RDF (Control)	12.30	9.67	10.98	11.72	15.76	13.74	153.45	219.19	186.32
T2- 50% RDF + 50%FYM	12.10	9.33	10.72	25.93	22.57	24.25	350.89	313.42	332.15
T3-50% RDF + 50%VC	10.30	8.47	9.38	20.58	28.48	24.53	281.21	395.49	338.35
T4-50% RDF+ 50%PM	11.23	8.70	9.97	24.19	29.52	26.86	331.32	410.06	370.69
T5-50% RDF + 50%WG	8.10	7.17	7.63	19.03	21.49	20.26	264.27	298.53	281.40
T6-100% RDF + 100% BF	7.17	6.70	6.93	18.14	17.19	17.67	242.74	238.79	240.77
T7-100% RDF + 100% BF	7.03	6.20	6.62	15.28	17.89	16.58	207.59	248.46	228.02
T8-100% VC + 100% BF	9.50	7.70	8.6	21.80	24.24	23.02	298.12	336.73	317.43
Mean	9.72	7.99		19.58	22.14		266.20	307.58	
	V	T	V x T	V	T	V x T	V	T	V x T
S.Em±	0.285	0.570	0.81	0.478	0.955	1.35	2.922	5.845	8.27
CD at 5%	0.823	1.647	N.S.	1.379	2.759	3.90	8.440	16.881	23.87

Conclusion

It was concluded from the present study that the role of different treatments of Integrated Nutrient Management (INM) is of vital importance for flower production and flower quality of African marigold. The application of RDF+ FYM and RDF+ Poultry Manure finally increased flower productivity and flower yield in cultivars Pusa Basanti and Pusa Narangi respectively

Conflict of Interest: None declared

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