# EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON FLOWER QUALITY AND BIOCHEMICAL PARAMETERS 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 long term basis, which may be achieved through 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 3 times. The results shown that 50% RDF and rest through poultry Manure gave 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 significantly higher flower yield /plot (26.86) and per hectare (370.69 q/ha).

**Key word : Flower initiation, Marigold, flower yield, 50% flowering**

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## INTROUCTION

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 plant, 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 (NHB Database, 2015). In MP flowers are grown in an area of 17.1 thousand ha with an annual production of 200.4 thousand MT (NHB Database, 2015). 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 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. nt Ma

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An Integrated Nutrie nagement System (INMS) may play a vital role in sustaining both soil health and crop production on long term basis, which may be achieved through 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.

## MATERIAL AND METHODS

The present investigation was carried out during *Kharif* season of 2009-2010 at Bahadari farm, K.N.K. College of Horticulture, Mandsaur (M.P.). Mandsaur is situated in Malwa plateau in

western part of M.P. at north latitude of 23.45 $^0$ to 24.13 $^0$and 74.44 $^0$ to 75.18 $^0$ 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 was $T_1$ : RDF @ 80:40:40 kg/ha (control), $T_2$ : 50% RDF + 50% RDN through FYM. $T_3$ : 50% RDF + 50% RDN through Vermicompost, $T_4$ : 50% RDF + 50% RDN through Poultry manure. $T_5$ : 50% RDF + 50% RDN through WellGro soil (Commercial formulation),$T_6$ : 100% RDF + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium*, $T_7$ : 50% RDF + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium,* and $T_8$ : 100% RDN by Vermicompost + 1.5 kg/ha *Azotobacter* + 1.5 kg/ha *Phosphobacterium*. The seeds were sown on 30$^{th}$ June 2009.

After executing the plan of 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% $P_2O_5$) and muriate of potash (60% $K_2O$), respectively. The half dose of nitrogen with full doses of $P_2O_5$ and $K_2O$ 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

**Fresh Weight Of flowers:**Variety $V_1$ (Pusa Basanti) recorded a lower mean fresh weight of flowers than the variety $V_2$ (Pusa Narangi) which recorded a higher value. Among the INM treatments, highest fresh weight of flowers was recorded by $T_4$ while the control showed lowest mean fresh weight of flowers. Considering interaction effect, in variety $V_1$ (Pusa Basanti) the treatment combination $V_1T_2$ (50% RDF + 50% Vermi compost) recorded a highest mean fresh weight of flowers while the lowest fresh weight of flowers was recorded in $V_1T_1$ (control). Similarly in variety $V_2$ (Pusa Narangi) the treatment combination $V_2T_4$ (50% RDF + 50 % Poultry Manure) recorded the highest fresh weight of flowers while the lowest fresh weight of flowers was recorded in $V_2T_1$ (control).

The increase in fresh weight of flowers in variety $V_1$ (Pusa Basanti) by the treatment combination $V_1T_2$ (50% RDF + 50% FYM) might be due to increase in number of flowers per plant by the application of FYM. These findings are in conformity with the findings of Gupta *et al.* (1999) in marigold, Mishra (1998) in *Gaillardia pulchella*, Singotker *et al.* (1995) in *Gaillardia pulchella* and Yadav and Bose (1997) in marigold. Similarly in variety $V_2$ (Pusa Narangi) the treatment combination $V_2T_4$ (50% RDF + 50 % Poultry Manure) recorded the highest fresh weight of flowers this might be due to increase in number of flowers per plant by the application of Poultry manure. This result supports the findings of Naik *et al.*, (2008) in African marigold, Singh and Kumar, (2008) in Rose and Verma and Thomas, (2009) in China aster.

**Flower diameter:**

Variety and treatment significantly affected the flower diameter, whereas the interaction effect was found to be non significant. Cultivar Pusa Basanti recorded a lower mean flower diameter than the cultivar Pusa Narangi. Among the INM treatments, the highest flower diameter was recorded by $T_4$ (50% RDF + 50 % Poultry Manure) while the control showed lowest mean flower diameter.

The highest flower diameter was recorded by $T_4$ (50% RDF + 50 % Poultry Manure). This might be due to good physical and biological condition of soil by the application of Poultry Manure. Similar results were also obtained by Naik *et al.*, (2008) in African marigold, Singh (2007) in Rose, Singh and Kumar, (2008) in Rose and Verma and Thomas, (2009) in China aster.

**Peduncle length:**

Variety and treatment significantly affected the peduncle length, whereas combined effect of factors was found to be non significant. Cultivar Pusa Basanti recorded a lower mean peduncle length than the cultivar Pusa Narangi. Among the INM treatments, the highest mean peduncle length was recorded by $T_2$ (50% RDF + 50% Vermi compost) while the control showed lowest mean peduncle length.

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present findings are indirectly supported by the work of Naik *et al.*, (2008) in African marigold, Singh (2007) in Rose, Gupta *et al.* (1999) in marigold, Mishra (1998) in *Gaillardia pulchella*, Singotker *et al.* (1995) in *Gaillardia pulchella* and Yadav and Bose (1997) in marigold.

**Vase life of flower:**

The longest mean vase life of different treatments on flowers was noted with $T_1$ (control) followed $T_2$ (50% RDF + 50% Vermi compost), $T_4$ (50% RDF + 50 % Poultry Manure) and $T_3$ (50% RDF + 50% Vermi compost) whereas the lowest was recorded in $T_7$ (100% RDF + 100% BF). The variety $V_2$ (Pusa Narangi) recorded a shortest mean vase life than the variety $V_1$ (Pusa Basanti). It was observed that flower vase life decreased with increasing the dose of nitrogen.

Similar findings were previously reported by Anuradha *et al.* (1990), in Marigold, Lodhi *et al.*, (1991) in Chrysanthemum, Belgaonker *et al.* (1997) in annual chrysanthemum and Mishra (1998) in *Gaillardia pulchella.*

**BIOCHEMICAL PARAMETERS**

**Chlorophyll content of leaves:**

Variety and treatment significantly affected the chlorophyll content, whereas their interaction effect was found to be statistically non-significant. Variety $V_1$ (Pusa Basanti) recorded lower mean chlorophyll content than the variety $V_2$ (Pusa Narangi). Among the INM treatments, highest chlorophyll content was also recorded by $T_4$ (50% RDF + 50 % Poultry Manure) while the control showed lowest chlorophyll content.

The reason for highest chlorophyll content by the treatment combination $T_4$ (50% RDF + 50 % Poultry Manure) might be attributed to the fact that after proper decomposition and mineralization, the poultry Manure supplied available nutrients directly to the plants and also had solubilizing effect on fixed form of nutrients in soil which ultimately increased the chlorophyll content of leaves. These results are supported by the findings of Sharma *et al.* (2008) in marigold.

**Total Carotenoids in Petals:**

Variety and treatment significantly affected the total carotenoid content, whereas their interaction effect was found to be non significant. Variety $V_1$ (Pusa Basanti) recorded a lower mean total

carotenoid content than the variety $V_2$ (Pusa Narangi). Among the INM treatments, highest total carotenoid content was also recorded by $T_4$ while the control showed lowest total carotenoid content.

The reason for highest total carotenoid content by the treatment combination $T_4$ (50% RDF + 50 % Poultry Manure) might be attributed to the fact that application of poultry manure might be attributed to good physical and biological conditions of soils which might have improved the physiology of plant and higher level of nitrogen and other nutrients (as P and K) are the major requirement for plant growth which are abundant in Poultry Manure. These results are supported by the findings of Sharma *et al.* (2008) in marigold and Karuppaiah (2006) in French marigold.

**Nitrogen uptake by plants:**

Variety $V_1$ recorded a lower mean nitrogen uptake than the variety $V_2$. Among the INM treatments, the highest nitrogen uptake was also recorded by $T_4$ while the control showed the lowest nitrogen uptake. Considering the interaction effect, in variety $V_1$ the treatment combination $V_1T_2$ (50% RDF + 50% Vermi compost) recorded a highest mean nitrogen uptake while the lowest nitrogen uptake was recorded in $V_1T_2$ (control). Similarly in variety $V_2$ the treatment combination $V_2T_4$ (50% RDF + 50 % Poultry Manure) recorded the highest nitrogen uptake while the lowest nitrogen uptake was recorded in $V_2T_4$ (control).

The reason for highest nitrogen uptake by the application of organic manures such as FYM and poultry manure might be attributed to the fact that addition of organic manures improves physio-chemical properties of soil which increases mineralization of nutrients hence improves quality of flowers, optimum growth and flower production. These findings are supported by Kumar and Lal, (2007) in marigold, Karuppaiah (2006) in French marigold, Sharma *et al.* (2006) in African marigold, Singh (2006) in Rose, Kundu *et al.* (2009) in African marigold and Dutt and Sonawane, (2006) in Chrysanthemum.

**Phosphorus uptake by plants:**

Variety $V_1$ recorded a lower mean phosphorus uptake than the variety $V_2$. Among the INM treatments, highest phosphorus uptake was recorded by $T_4$ while the control showed lowest

phosphorus uptake. Considering the interaction effect, in variety $V_1$ the treatment combination $V_1T_2$ (50% RDF + 50% Vermi compost) recorded a highest mean phosphorus uptake while the lowest phosphorus uptake was recorded in $V_1T_1$ (control). Similarly in variety $V_2$ the treatment combination $V_2T_4$ (50% RDF + 50 % Poultry Manure) recorded the highest phosphorus uptake while the lowest phosphorus uptake was recorded in $V_2T_4$ (control).

The reason for highest phosphorus uptake by the application of organic manures such as FYM and poultry manure might be attributed to the fact that addition of organic manures improves physio-chemical properties of soil which increases mineralization of nutrients hence improves quality of flowers, optimum growth and flower production. These findings are supported by Kumar and Lal, (2007) in marigold, karuppaiah (2006) in French marigold, Sharma *et al.* (2006) in African marigold, Singh (2006) in Rose, Kundu *et al.* (2009) in African marigold and Dutt and Sonawane, (2006) in Chrysanthemum.

**Potassium uptake by plants:**

Potassium uptake was significantly influenced by varieties while the treatment and interaction effect was found to be non significant. Variety $V_1$ recorded a lower mean potassium uptake than the variety $V_2$.

The highest phosphorus uptake by the application of organic manures such as FYM and poultry manure might be due to the fact that addition of organic manures improves physio-chemical properties of soil which increases mineralization of nutrients hence improves quality of flowers, optimum growth and flower production. These findings are supported by Kumar and Lal, (2007) in marigold, Karuppaiah (2006) in French marigold, Sharma *et al.* (2006) in African marigold, Singh (2006) in Rose, Kundu *et al.* (2009) in African marigold and Dutt and Sonawane, (2006) in Chrysanthemum.

**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.

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**Table 1 : Effect of different INM treatment on the Flower quality characters of African marigold**

| Treatments | Fresh Weight of flowers | | | Flower Diameter | | | Peduncle Length | | | Vase life | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean |
| T1- RDF (Control) | **4.60** | **7.23** | 5.92 | **3.70** | **6.75** | 5.23 | **4.33** | **5.70** | 5.02 | **12.30** | **9.67** | 10.98 |
| T2- 50% RDF + 50%FYM | **9.37** | **9.77** | 9.57 | **6.80** | **7.42** | 7.11 | **7.77** | **9.27** | 8.52 | **12.10** | **9.33** | 10.72 |
| T3-50% RDF + 50%VC | **7.34** | **13.47** | 10.40 | **6.13** | **7.80** | 6.97 | **7.00** | **8.03** | 7.52 | **10.30** | **8.47** | 9.38 |
| T4-50% RDF+ 50%PM | **8.67** | **14.42** | 11.54 | **6.42** | **7.97** | 7.19 | **7.10** | **8.57** | 7.83 | **11.23** | **8.70** | 9.97 |
| T5-50% RDF + 50%WG | **6.69** | **9.34** | 8.01 | **5.62** | **7.38** | 6.50 | **6.47** | **7.30** | 6.88 | **8.10** | **7.17** | 7.63 |
| T6-100% RDF + 1.5 kg/ha BF | **6.23** | **8.08** | 7.16 | **5.32** | **7.20** | 6.26 | **6.33** | **6.90** | 6.62 | **7.17** | **6.70** | 6.93 |
| T7-100% RDF + 1.5 kg/ha BF | **5.08** | **7.69** | 6.39 | **5.10** | **7.03** | 6.07 | **6.23** | **6.63** | 6.43 | **7.03** | **6.20** | 6.62 |
| T8-100% VC + 1.5 kg/ha BF | **8.27** | **12.31** | 10.29 | **6.34** | **7.55** | 6.95 | **6.97** | **7.57** | 7.27 | **9.50** | **7.70** | 8.6 |
| Mean | 7.03 | 10.29 | | 5.68 | 7.38 | | 6.53 | 7.50 | | 9.72 | 7.99 | |
| | **V** | **T** | **V x T** | **V** | **T** | **V x T** | **V** | **T** | **V x T** | **V** | **T** | **V x T** |
| S.Em± | 0.27 | 0.550 | 0.78 | 0.217 | 0.435 | 0.62 | 0.305 | 0.609 | 0.86 | 0.285 | 0.570 | 0.81 |
| CD at 5% | 0.79 | 1.588 | 2.25 | 0.628 | 1.256 | N.S. | 0.879 | 1.759 | N.S. | 0.823 | 1.647 | N.S. |

**Table 2: Chlorophyll content in leaves, carotenoid content in petals and N, P, K Uptake as influenced by INM treatment in marigold**

| Treatments | Chlorophyll Content | | | Carotenoid content | | | N uptake | | | P uptake | | | K uptake | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean |
| T1- RDF (Control) | **0.84** | **1.33** | 1.08 | **0.27** | **0.39** | 0.33 | **2.13** | **2.56** | 2.35 | **0.21** | **0.59** | 0.4 | **0.30** | **0.48** | 0.39 |
| T2- 50% RDF + 50%FYM | **1.33** | **1.51** | 1.42 | **0.39** | **0.55** | 0.47 | **2.72** | **2.78** | 2.75 | **0.66** | **0.69** | 0.67 | **0.44** | **0.54** | 0.49 |
| T3-50% RDF + 50%VC | **1.42** | **1.65** | 1.53 | **0.45** | **0.62** | 0.54 | **2.44** | **2.95** | 2.69 | **0.58** | **0.77** | 0.68 | **0.37** | **0.57** | 0.47 |
| T4-50% RDF+ 50%PM | **1.57** | **1.75** | 1.66 | **0.48** | **0.67** | 0.58 | **2.64** | **3.04** | 2.84 | **0.64** | **0.79** | 0.71 | **0.42** | **0.59** | 0.50 |
| T5-50% RDF + 50%WG | **1.26** | **1.46** | 1.36 | **0.34** | **0.51** | 0.43 | **2.35** | **2.71** | 2.53 | **0.54** | **0.67** | 0.61 | **0.35** | **0.53** | 0.44 |
| T6-100% RDF + 1.5 kg/ha BF | **1.17** | **1.42** | 1.29 | **0.31** | **0.47** | 0.39 | **2.27** | **2.68** | 2.45 | **0.52** | **0.65** | 0.59 | **0.34** | **0.52** | 0.43 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **T7-100% RDF + 1.5 kg/ha BF** | **0.94** | **1.36** | 1.15 | **0.29** | **0.43** | 0.36 | **2.23** | **2.65** | 2.44 | **0.39** | **0.63** | 0.52 | **0.33** | **0.50** | 0.42 |
| **T8-100% VC + 1.5 kg/ha BF** | **1.38** | **1.52** | 1.45 | **0.43** | **0.58** | 0.51 | **2.47** | **2.83** | 2.65 | **0.62** | **0.70** | 0.66 | **0.38** | **0.55** | 0.46 |
| **Mean** | 1.24 | 1.50 | | 0.37 | 0.53 | | 2.41 | 2.77 | | 0.52 | 0.69 | | 0.37 | 0.54 | |
| | **V** | **T** | **V x T** | **V** | **T** | **V x T** | **V** | **T** | **V x T** | **V** | **T** | **V x T** | **V** | **T** | **V x T** |
| **S.Em±** | 0.046 | 0.092 | 0.13 | 0.028 | 0.056 | 0.08 | 0.023 | 0.043 | 0.06 | 0.016 | 0.033 | 0.05 | - | - | - |
| **CD at 5%** | 0.133 | 0.265 | N.S. | 0.081 | 0.162 | N.S. | 0.063 | 0.127 | 0.18 | 0.048 | 0.097 | 0.14 | N.S. | N.S. | N.S. |