I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of Organic and Inorganic Fertilizers on Growth and Yield of African Marigold *(Tagetes erecta L.)* cv. Pusa Narangi Gainda

*Jadhav, P.B., **Alka Singh, **Mangave, B. D., *Patil, N.B. ***Patel, D.J. and *Dekhane, S.S.

ABSTRACT: *The present investigation entitled "Effect of organic and inorganic fertilizers on growth and yield of African Marigold (Tagetes erecta L.) cv. Pusa Narangi Gainda was undertaken at American Spring and Pressing Works PVT. Ltd., Agricultural Research and Development Foundation, District Thane, Village- Nare (MH), India during the Rabi season of the year 2013-14. The experiment was laid out in Randomized Block Design with eight treatments replicated thrice. Studies showed significant effect on plant height (54 cm), no. of branches per plant (6.80), total no. of flowers per plant (39.40), flower yield per plant (359.68g), flower yield per plot (17.26kg), flower yield per m² (2.66kg) and hectare (26.64t.) was observed in treatment with 75% RDN + 60kg P_2O_5 ha^{-1} + 60 kg K_2O ha^{-1} + Azotobacter + Enriched banana pseudo stem Sap (T_8) The maximum gross return (532853.4per ha), net return (`451733.4 per ha) and cost benefit ratio (1:5.57) was recorded maximum with same treatment i.e.T_8 (75% RDN + 60kg P_2O_5 ha^{-1} + 60 kg K_2O ha^{-1} + Azotobacter + Enriched banana pseudo stem Sap) under Tansa farm (MH) condition.*

Keywords: *Tagetes erecta L., Marigold, Organic Manures, Azotobacter, Enriched banana pseudo stem Sap etc.*

INTRODUCTION

African Marigold *(Tagetes erecta* L.) cv. Pusa Narangi Gainda belongs to family *Asteraceae* or *Compositae* is the most commonly grown loose flower and is extensively used in religious and social functions (Singh *et al.*, 2001). It is gaining popularity on account of its easy culture, wide adaptability, and increasing demand in the Asian subcontinent (Asif, 2008). Sometimes, the whole plant is used for decorations. It can be planted in beds for mass display, in mixed borders and can also be grown in pots (Desai, 1967).

Different varieties of African marigold vary in plant height and spread, flower size, quality and yield (Jawaharlal, 2004). The flowers are large and globular in shape. Colour shades vary from light yellow to creamy yellow, bright yellow, cadmium orange, deep orange, sulphur, yellow and white. The chromosome number of African marigold is 2n = 24.

It is now a day's gaining commercial importance as a source of carotenioid pigments. The principal pigment present in the flowers is xanthophyll, particularly lutien accounts for 80 to 90 percent in the form of esters of plamitic and myristic acid. The ground blossom meals (petal meal) or the extract usually saponified for better absorption is added to the poultry feed (Bosma *et al.*, 2003). These products are trade as "Aztec marigold" or marigold extract as "Adoptinal".

Organic farming is not merely non-chemical agriculture, but is a system integrating relations between soil, plant and water. A judicious combination of chemical fertilizers, organic manures and biofertilizer should be formulated for crops and cropping system within the ecological, social and economic possibilities (Dubey *et al.*, 2011). Organic farming helps in soil health, proper energy flow in soil, crop, water environment systems, keeps biological life cycle alive and helps in sustaining considerable levels in yield (Lampkin, 1990). It is mainly based on principles of restoration of soil

* ASPEE, Agricultural Research and Development Foundation, 'ASPEE HOUSE', P.O.Box No. 7602, B. J. Patel Road, Malad (W), Mumbai-400 064 (MH).

** Dept. of Floriculture and Landscape Architecture, ACHF, NAU, Navsari-396 450 (GJ).

** BA College of Agriculture, AAU, Anand (GJ) -388 110

Correspondence author E-mail: tropicalsubtropical@gmail.com

organic matter in the form of humus, increasing microbial population, skilful application of the factors contributing soil life, health and treating manures in bio-dynamic way (Pathak and Ram, 2003).

Biofertilizers are the products containing living cells of different types of micro-organisms, which are capable of mobilizing nutritive elements from non-usable form to usable form through biological process. Now-a-days, different biofertilizers are available in the markets. Azotobacter is free living N_2 fixing bacteria that help in root development and plant growth (Kader, 2002).

Keeping above benefits points in view an investigation was carried out to find out the "Effect of organic and inorganic manures on growth and yield of African marigold (*Tagetes erecta* L.)" cv. Pusa Narangi Gainda with the objectives: To find out the effect of organic and inorganic manures on growth and yield of African marigold (*Tagetes erecta* L.)" cv. Pusa Narangi Gainda and to work out the economics of different treatments.

MATERIALS AND METHODS

Site Description

A field experiment entitled "Effect of organic and inorganic manures on growth and yield of African marigold (*Tagetes erecta* L.)" cv. Pusa Narangi Gainda" was conducted at American Spring and Pressing Works PVT. Ltd., Agricultural Research and Development Foundation, District Thane, Village-Nare (MH), during season of the year *Rabi* 2013-2014. The experiment was laid out in Randomized Block Design with eight treatments and replicated thrice. The marigold cv. Pusa Narangi Gainda seedling was raised at nursery at 15 X 5-7 cm distance in a plot size 3 X 1m and transplanted in plot size 3.6 X 1.8 m at spacing 45 x 30 cm during December, 2013. All agronomical practices in virtue were employed from time to time. The nursery beds were maintained systematically up to 45 days till the seedlings were ready for transplanting. Seedlings of marigold were transplanted in the main field when they had 2-3 true leaf stage. During the transplanting soil was pressed firmly around the seedlings so that seedlings will not be disturbed by irrigation water immediately after transplanting.

Treatment Details

Different eight treatments *viz.*, T_1- 200kg N ha^{-1} + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} (RDF-Control), T_2- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2}, T_3- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2}+ Azotobacter 5L ha^{-1}, T_4- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2}+ VAM 15kg ha^{-1}, T_5- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + VAM 15kg ha^{-1}, T_6- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Enriched Banana pseudo stem Sap 1%, T_7- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2}+ Enriched Banana pseudo stem Sap1%, T_8- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap1% were given to different plots. The biofertilizers namely *Azotobacter* @ 5L ha^{-1} and VAM (Vesicular arbuscular mycorrhiza) @ 15kg ha^{-1} were applied through soil application near the root zone area of plant in the form of drenching, after calculating on the basis of per plot, according to the treatments at the time of transplanting. Vermicompost 0.1kg m^{-2} and NPK were applied according to treatments in soil one day before transplanting. Half dose of N and total dose of P_2O_5 and K_2O were applied as basal dose and second dose of remaining half N was applied 30 DAT and well mixed with the soil. Nitrogen was applied in the form of urea; whereas, phosphate and potash were applied in the form of SSP (Single Super Phosphate) and muriate of potash, respectively. The Enriched banana Pseudo stem Sap was drench at two times in the soil in related plot according to treatments at fortnight intervals from the date of transplanting.

Observations Recorded

The observation regarding vegetative parameters *viz.*, plant height and no. of branches were recorded 60 days after transplanting. Whereas flowering parameters were recorded at each harvesting interval and cumulative data was subjected to statistical analysis. Economics was calculated on the basis of treatment cost, yield and selling prize of the flowers.

Statistical Analysis

The recorded data were statistically analyzed (ANOVA analysis) using the software WASP, (developed at ICAR Research Complex for Goa, India). Sources of variation were fertilizer treatments. Mean comparisons were performed using LSD test to determine whether the difference between the variables were significant at $P < 0.05$.

RESULTS

The present investigation was aimed at identifying suitable organic and inorganic manures treatments for marigold cultivation with respects to growth and yield attributes. Eight treatments including control were

evaluated during the *Rabi* season of the year 2013-14 at American Spring and Pressing Works PVT. Ltd., Agricultural Research and Development Foundation, District- Thane, Village- Nare (MH), India, 421312.

All the vegetative and flowering characters like plant height, no. of branches per plant, total no. of flowers per plant, flowers yield per plant, flowers yield per plot, flowers yield per m^2 and hectare, gross realization (₹.ha),net return (₹. ha) and CBR were significantly affected by different organic and inorganic fertilizer treatments in marigold cv. Pusa Narangi Gainda.

Vegetative and Flowering

It is evident from table1and 2 that the plant height (54cm), no. of branches per plant (6.80), total no. of flowers per plant (39.40), flowers yield per plant (359.68g), flowers yield per plot (17.26kg), flowers yield per m^2 (2.66kg) and flowers yield per hectare (26.64t. ha^{-1}) was recorded significantly highest in treatment T_8 i.e. 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap 1% which was followed by treatment T_7- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2} + Enriched Banana pseudo stem Sap1%. Whereas treatment T_1- 200kg N haÎ¹ + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} (RDF-Control) recorded minimum plant height (42.25cm), no. of branches per plant (4.40), total no. of flowers per plant (22.80), flowers yield per plant (173.97g), flowers yield per plot (8.35kg), flowers yield per m^2 (1.29kg) and flowers yield per hectare (12.89t. ha^{-1}).

ECONOMICS

The maximum gross return (' 532853.4 per ha), net return (' 451733.4 per ha) and cost of benefit ratio (1:5.57) was maximum in treatment with T_8- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap 1% followed by T_5- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + VAM 15kg ha^{-1}.While least CBR value (1:2.87) was found in T_2- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Vermicompost 0.1kg m^{-2}.

On the basis of the experiment as well as economic point of views, an application of biofertilizers in combination with chemical fertilizers produced its significant impact on cost benefits ratio. Both these treatments (T_8 and T_5) were found economical, profitable and proved highly remunerative under the Tansa (Maharashtra, India) conditions for growing the marigold cv. "Pusa Narangi Gainda", which also improved the soil health.

DISCUSSION

Plant nutrients supplied through organic fertilizer sources have profound effect on growth and yield of crop as the biological decomposition processes of the organic sources supply nutrients to the plants in the available forms. The plants nourished with the treatment T_8- 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap 1% had resulted in the higher values of growth and yield attributes. The present findings explain that the combined application of inorganic and biofertilizers are effective in producing more number of branches than the inorganic fertilizers alone. Results pertaining to the above growth parameters could be attributed to the appropriate nutrients in available form under this type of combination. Nitrogen is the major constituent of proteins, enzymes, hormones, vitamins, alkaloids, chlorophyll and their synthesis in plants that influence plant growth. Plant growth is thus known to be accelerated by the adequate supply and availability of nitrogen in association with biofertilizers (Kukde *et al.,* 2006; Yasari and Patwardhan, 2007).

Azotobacter is the free living nitrogen fixing bacteria which fix the nitrogen equivalent to 30-40 kg ha^{-1}. It also produces hormones like IAA and GA_3, vitamin like biotin (Vitamin B_7) and folic acid (Kader, 2002) and with judicious use of organic matter ensures good growth and increase productivity. The contribution of *Azotobacter* in plant growth is also due to excretion of ammonia in presence of root exudes that enhance and regulate nutrient uptake by plants as explained earlier by Yasari and Patwardhan 2007. Banana pseudo stem enriched sap contains essential plant nutrients along with growth regulators like GA_3 and cytokinin and trace of micronutrients (Patil and Kolambe, 2011) which boosts the plant growth.

Application of organic sources, in soil, improve the physical properties of soil such as aggregation, aeration, permeability and water holding capacity (Govindarajan and Thangaraju, 2001), which further promote growth and development of plants. Further, efficacy of the inorganic fertilizer in combination with biofertilizers has also been known to have pronounced effect on plant growth and development by production of more photosynthates as also observed by Yasari and Patwardhan, 2007.

Thus, the treatment T_8 (75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap1%) gave better result in all growth and yield attributes. The results of the present investigation with regard to nitrogen and bio-fertilizer

are corroborated by Mukesh *et al.,* 2007, Ajit Kumar, 2002 and Shadanpour *et al.,* 2011 in marigold; Munikrishnappa *et al.,* 2004 in tuberose.

However, the influence of enriched banana pseudo stem sap along with inorganic fertilizer and biofertilizer has not been earlier studied in marigold. Thus, combination of enriched banana pseudo stem sap along with 75% RDN in association with biofertilizer has shown much pronounce effect with regard to vegetative as well as flower characters that ultimately contributed to improved cost benefit ratio.

Table 1
Effect of Organic and Inorganic Fertilizers on Growth and Yield Attributes of Marigold Cultivar Pusa Narangi Gainda (PNG).

Treatment	*Plant height, cm*	*No. of branches plant^{-1}*	*Total no. of flower plant^{-1}*	*Fresh weight of single flower, (g)*	*Flowers yield plant $^{-1}$, (gm)*	*Flowers yield plot^{-1}, (kg)*
	1	*2*	*3*	*4*	*5*	*6*
T_1	42.25	4.40	22.80	7.64	173.97	8.35
T_2	47.94	4.60	25.00	7.91	197.50	9.48
T_3	48.64	4.80	28.00	8.19	231.18	11.10
T_4	48.99	5.00	29.00	8.31	238.89	11.47
T_5	51.69	5.20	32.00	8.40	268.94	12.91
T_6	53.23	5.60	33.00	8.58	285.24	13.69
T_7	53.87	6.00	38.80	8.72	337.73	16.21
T_8	54.00	6.80	39.40	9.11	359.68	17.26
SE.m ±	2.36	0.51	2.33	0.33	23.45	1.13
C. D. @ 0.05	6.84**	1.48**	6.75**	N.S.	67.94**	3.26**

Table 2
Effect of Organic and Inorganic Fertilizers on Yield of Marigold Cultivar Pusa Narangi Gainda (PNG)

Treatment	*Flower yield square meter^{-1}, (kg)*	*Flower yield hector^{-1}, (kg)*	*Flower yield per hector, (t. ha^{-1})*	*Cost of production, (₹. ha^{-1})*	*Total gross realization, (₹. ha^{-1})*	*Net realization, (₹. ha^{-1})*	*C:B:R*
	7	*8*	*9*	*10*	*11*	*12*	*13*
T_1	1.29	12886.81	12.89	64620	257736.2	193116.2	1:2.99
T_2	1.46	14629.63	14.63	75620	292592.6	216972.6	1:2.87
T_3	1.71	17124.15	17.12	62620	342483	279863	1:4.47
T_4	1.77	17695.41	17.70	77020	353908.2	276888.2	1:3.60
T_5	1.99	19921.63	19.92	62570	398432.6	335862.6	1:5.37
T_6	2.11	21128.89	21.13	80620	422577.8	341957.8	1:4.24
T_7	2.50	25016.74	25.02	95620	500334.8	404714.8	1:4.23
T_8	2.66	26642.67	26.64	81120	532853.4	451733.4	1:5.57
SE.m ±	0.17	1737.27	1.74				
C. D. @ 0.05	0.50**	5032.66**	5.03**				

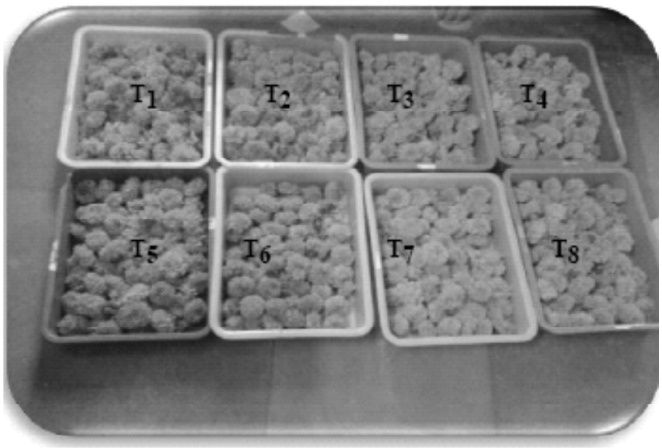

Photo 1: Flower photos

CONCLUSION

In conclusion the response of African marigold varies with application of organic and inorganic manures but the application of 75% RDN + 60kg P_2O_5 ha^{-1} + 60kg K_2O ha^{-1} + Azotobacter 5L ha^{-1} + Enriched Banana pseudo stem Sap 1% to African marigold cv. Pusa Narangi Gainda gave maximum growth and yield attributes with high cost benefit ratio.

REFERENCES

Ajit Kumar. (2002), Effect of organic and inorganic fertilizers on growth, yield and post harvest life of marigold. *M.Sc. (Agri) Thesis* submitted to University of Agricultural Sciences, Bangalore.

Asif, M. (2008), Effect of Various NPK Levels on Growth, Yield and Xanthophyll Contents of Marigold. *M.Sc. Thesis*. Inst of Hort Sci, Univ of Agric, Faisalabad, Pakistan, pp. 95.

Bosma, T. L., Dole, J. M. and Maness, N. O. (2003), Crop ecology, management and quality: Optimizing marigold (*Tagetes erecta* L.) petal and pigment yield. *Crop Sci.,* 43: 2118-2124.

Desai, B. L. (1967), Flower description of *Tagetes erecta* In: Seasonal flower, Indian Agricultural Research Institute, New Delhi.

Dubey, P. K., Pandey, C. S. and Bharadwaj, S. B. (2011), Effect of integrated nutrient management on growth, yield attributes and yield of fenugreek (*Trigonella foenumgraecum* L.). *Int. Agric. Stat. Sci.*, 7(1): 327-339.

Govindarajan, K. and Thangaraju, M. (2001), *Azospirillum*-a potential inoculant for horticultural crops. *South Indian Hort.,* 49 : 223-235.

Jawaharlal, M. (2004), Traditional Floriculture. Emerging Trends in Ornamental Horticulture, ISOH, New Delhi, pp. 5-10.

Jeyabasakaran, K. J., Pandey, S. D., Mustaff, M. M. and Sathiamoorthy, S. (2001), Effect of different organic manures with graded levels of inorganic fertilizers on ratoon of pooven banana. *South Indian Hort.,* 49 : 105-109.

Kader, M. A. (2002), Effects of Azotobacter inoculants on the yield and nitrogen uptake by wheat. *On line J. Biol. Sci.*, 2: 259-261.

Kukde, S., Pillewn S., Meshram N., Khobragade H., and Khobragade, Y. R. (2006), Effect of organic manure and biofertilizer on growth, flowering and yield of tuberose cv. Single. *J. Soils and Crops*, 6 (2): 414-416.

Lampkin, N. (1990), In : *Organic Farming,* Ipswich, U. K. Press Books., pp. 701-710.

Mukesh, K., Sultan S. S. and Devi, S. S. K. (2007), Effect of different N sources on yield, nutrients and chlorophyll content of marigold cv. Pusa Narangi. *Env. Eco.,* 25S: Special 4, 1120-1123.

Munikrishnappa, P. M., Katimani, K. N. and Ravikumar, M. (2004), Effect of vermicompost on growth and yield of tuberose *(Pollianthus tuberose L.*) under semiarid tropics of north Karnataka. National symposium on Recent Trends and Future Strategies in Ornamental Horticulture, University of Agricultural Sciences, Dharwad., pp: 61.

Pathak, R. K. and Ram, R. A. (2003), Organic farming systems prevalent in India. *Nation. Symp. Organic Farming in Horticulture for Sustainable Production,* 29-30 August, Central Institute of Subtropical Hort. Lucknow., pp. 1-2.

Patil, R. J. and Kolambe, B. N. (2011), Development of value added products from banana pseudostem (An Overview of Progress) (NAIP Component II), pp. 16.

Shadanpour, F., Torkashvand, A.M. and Majd, K. H. (2011), The effect of cow manure vermicompost as the planting medium on the growth of Marigold. *Annals of Biological Research*, 2 (6): 109-115.

Singh, H. P., Schiva, T., Zabeltetz, C. Von and Dadlani, N. K. (2001), An integrated approach for small scale greenhouse floriculture in India. FAO., pp. 203.

Yasari, E. and Patwardhan, A. M. (2007), Effects of (*Azotobacter* and *Azospirillium*) Inoculants and chemical fertilizers on growth and productivity of Canola (Brassica napusL.). *Asian J. Plant Sci.,* 6 (1): 77-82.