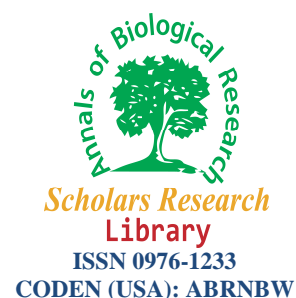




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## Effect of organic and inorganic fertilizers on growth and yield of African Marigold (*Tagetes erecta* L.) Cv. Pusa Basanti Gainda

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### ABSTRACT

The present investigation entitled "Effect of organic and inorganic fertilizers on growth and yield of African Marigold (*Tagetes erecta* L.) Cv. Pusa Basanti 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 times. Studies showed significant effect on plant height (58.94 cm), no. of branches per plant (7.20), total no. of flowers per plant (38.80), flower yield per plant (348.93), flower yield per plot (16.75kg), flower yield per m<sup>2</sup> (2.58kg) and hectare (25.85t.) was observed in treatment with 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub>ha<sup>-1</sup> + 60 kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter + Enriched banana pseudo stem Sap (T<sub>8</sub>). The maximum gross return (516930.4 per ha), net return (435810.4 per ha) and benefit cost ratio (5.37:1) was recorded maximum with same treatment i.e. T<sub>8</sub> (75% RDN + 60kg P<sub>2</sub>O<sub>5</sub>ha<sup>-1</sup> + 60 kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter + Enriched banana pseudo stem Sap) under Tansa farm (MH) area.

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

### INTRODUCTION

African Marigold (*Tagetes erecta* L.) Cv. Pusa Basanti Gainda belongs to family Asteraceae or Compositae is the most commonly grown loose flower and is extensively used in religious and social functions [1]. It is gaining popularity on account of its easy culture, wide adaptability, and increasing demand in the Asian subcontinent [2]. 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 [3].

Different varieties of African marigold vary in plant height and spread, flower size, quality and yield [4]. 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 carotenoid pigments. The principal pigment present in the flowers is xanthophyll, particularly lutein accounts for 80 to 90 percent in the form of esters of palmitic and myristic acid. The ground blossom meals (petal meal) or the extract usually saponified for better absorption is added to the poultry feed [5]. 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 [6]. 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 [7]. It is mainly based on principles of restoration of soil 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 [8].

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<sub>2</sub> fixing bacteria that help in root development and plant growth [9].

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 Basanti Gaiinda 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 Basanti Gaiinda 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 Basanti Gaiinda” was conducted at ASPEE, 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 times. The marigold Cv. Pusa Basanti Gaiinda 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<sub>1</sub>- 200kg N ha<sup>-1</sup> + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> (RDF-Control), T<sub>2</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup>, T<sub>3</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup> + Azotobacter 5L ha<sup>-1</sup>, T<sub>4</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup> + VAM 15kg ha<sup>-1</sup>, T<sub>5</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + VAM 15kg ha<sup>-1</sup>, T<sub>6</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Enriched Banana pseudo stem Sap 1%, T<sub>7</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup> + Enriched Banana pseudo stem Sap 1%, T<sub>8</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + Enriched Banana pseudo stem Sap 1% were given to different plots. The biofertilizers namely *Azotobacter* @ 5L ha<sup>-1</sup> and VAM (Vesicular arbuscular mycorrhiza) @ 15kg ha<sup>-1</sup> 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<sup>-2</sup> and NPK were applied according to treatments in soil one day before transplanting. Half dose of N and total dose of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O 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 ASPEE, 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<sup>2</sup> and hectare, gross realization (₹.ha), net return (₹.ha) and BCR were significantly affected by different organic and inorganic fertilizer treatments in marigold Cv. Pusa Basanti Gaiinda.

### Vegetative and flowering

It is evident from table 1 and 2 that the plant height (58.94cm), no. of branches per plant (7.20), total no. of flowers per plant (38.80), flowers yield per plant (348.93g), flowers yield per plot (16.75kg), flowers yield per m<sup>2</sup> (2.58kg) and flowers yield per hectare (25.85t. ha<sup>-1</sup>) was recorded significantly highest in treatment T<sub>8</sub> i.e. 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + Enriched Banana pseudo stem Sap 1% which was followed by treatment T<sub>7</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup> + Enriched Banana pseudo stem Sap 1%. Whereas treatment T<sub>1</sub>- 200kg N ha<sup>-1</sup> + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> (RDF-Control) recorded minimum plant height (41.66cm), no. of branches per plant (4.60), total no. of flowers per plant (22.40), flowers yield per plant (176.08g), flowers yield per plot (8.45kg), flowers yield per m<sup>2</sup> (1.30kg) and flowers yield per hectare (13.04t. ha<sup>-1</sup>).

### ECONOMICS

The maximum gross return (₹ 516930.4 per ha), net return (₹ 435810.4 per ha) and cost of benefit cost ratio (5.37:1) was maximum in treatment with T<sub>8</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + Enriched Banana pseudo stem Sap 1% followed by T<sub>5</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + VAM 15kg ha<sup>-1</sup>. While least BCR value (3.02:1) was found in T<sub>2</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Vermicompost 0.1kg m<sup>-2</sup>.

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<sub>8</sub> and T<sub>5</sub>) were found economical, profitable and proved highly remunerative under the Tansa (Maharashtra, India) conditions for growing the marigold cv. "Pusa Basanti Gaiinda", 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<sub>8</sub>- 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + 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 from 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 [10][11].

*Azotobacter* is the free living nitrogen fixing bacteria which fix the nitrogen equivalent to 30-40 kg ha<sup>-1</sup>. It also produces hormones like IAA and GA<sub>3</sub>, vitamin like biotin (Vitamin B<sub>7</sub>) and folic acid [9] 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 [11]. Banana pseudo stem enriched sap contains essential plant nutrients along with growth regulators like GA<sub>3</sub> and cytokinin and trace of micronutrients [12], 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 [13], 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 [11].

Thus, the treatment T<sub>8</sub> (75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + Enriched Banana pseudo

stem Sap 1%) 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 [14][15][16] in marigold; [17] 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 benefit cost ratio.

**Table 1: Effect of Organic fertilizers on growth and yield of Marigold cultivar Pusa Bansanti Gaiinda (PBG)**

Treatment	Plant height, cm	No. of branches plant <sup>-1</sup>	Total no. of flower plant <sup>-1</sup>	Fresh weight of single flower, (g)	Flowers yield plant <sup>-1</sup> , (gm)	Flowers yield plot <sup>-1</sup> , (kg)	Flower yield square meter <sup>-1</sup> , (kg)	Flower yield hector <sup>-1</sup> , (kg)
	1	2	3	4	5	6	7	8
T <sub>1</sub>	41.66	4.60	22.40	7.86	176.08	8.45	1.30	13042.67
T <sub>2</sub>	44.20	4.80	25.80	7.92	204.96	9.84	1.52	15182.52
T <sub>3</sub>	47.48	5.00	28.20	8.33	233.88	11.23	1.73	17324.44
T <sub>4</sub>	48.15	5.20	29.80	8.49	254.83	12.23	1.89	18876.15
T <sub>5</sub>	49.46	5.40	32.60	8.52	279.28	13.41	2.07	20687.41
T <sub>6</sub>	54.00	5.80	34.60	8.60	304.93	14.64	2.26	22587.76
T <sub>7</sub>	58.44	6.40	36.20	8.66	315.05	15.12	2.33	23337.04
T <sub>8</sub>	58.94	7.20	38.80	9.00	348.93	16.75	2.58	25846.52
SE.m ±	3.74	0.52	2.31	0.40	25.82	1.24	0.19	1912.42
C.D.@0.05	10.83**	1.50**	6.69**	N.S	74.79**	3.59**	0.55**	5540.07**

**Table 2: Economics of different treatments**

Treatment	Flower yield per hector (t./ha)	Cost of production (₹/ha)	Total Gross Realization (₹/ha)	Net Realization (₹/ha)	BCR
	9	10	11	12	13
T <sub>1</sub>	13.04	64620	260853.4	196233.4	3.04:1
T <sub>2</sub>	15.18	75620	303650.4	228030.4	3.02:1
T <sub>3</sub>	17.32	62620	346488.8	283868.8	4.53:1
T <sub>4</sub>	18.88	77020	377523	300503	3.90:1
T <sub>5</sub>	20.69	62570	413748.2	351178.2	5.61:1
T <sub>6</sub>	22.59	80620	451755.2	371135.2	4.60:1
T <sub>7</sub>	23.34	95620	466740.8	371120.8	3.88:1
T <sub>8</sub>	25.85	81120	516930.4	435810.4	5.37:1
SE.m ±	1.91				
C.D.@0.05	5.54**				

Prizes:-

1. Azotobactor-250 gm/ha-100 ₹
2. Vermicompost-3000 ₹ /tonne
3. Urea -12.08 ₹ /kg,
4. Single super phosphate-18.75 ₹ /kg,
5. Muriate of potash- 10.51 ₹ /kg,
6. 1 kg flowers selling prize- 20 ₹ ,
7. Labour charge/day-120 ₹
8. **Enriched Banana pseudo stem Sap-100 Rs/ Lit**



**Photo 1. General view of the experiment cv. Pusa Basanti Gaiinda**

#### CONCLUSION

In conclusion the response of African marigold varies with application of organic and inorganic manures but the application of 75% RDN + 60kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + 60kg K<sub>2</sub>O ha<sup>-1</sup> + Azotobacter 5L ha<sup>-1</sup> + Enriched Banana pseudo stem Sap 1% to African marigold cv. Pusa Basanti Gaiinda gave maximum growth and yield attributes with high benefit cost ratio.

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