

Full Length Research Paper

## Response of Nutripellet placement on Marigold yield and its components

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Nutripellet Pack has 3 parts viz., top bioinoculant mixture, central manure pellet and bottom fertilizer pellet. On the top, bioinoculants mixture responsible for N<sub>2</sub> fixation, P and Zn solubilization and biocontrol agents are placed as a powder or granules. Highly decomposed manure having C:N ratio below 30:1 enriched with P, micronutrients and pesticide/ fungicide is pelleted with pelleting device and placed at the centre. At the bottom, a mixture of NPK fertilizers made in pellet form and encapsulated in polymer paper (bio degradable) pouch is placed. The nutrients in fertilizer pellet are in amount equal to the yield target of the crop. To study the Nutripellet (Nutripellet is a packet in tubular form having several inputs viz., fertilizers, manures; for preparing manure pellet, enriched vermicompost was used, fungicide and bioinoculants) application of nutrients on the yield of marigold (*Tagetes erecta* L.), a field experiment was conducted with following treatments viz., T<sub>1</sub>, Control; T<sub>2</sub> and T<sub>3</sub>, 100 and 75% NPK surface/broadcast application of fertiliser, T<sub>4</sub> and T<sub>5</sub>, 100 and 75% NPK- Nutripellet (Diammonium phosphate (DAP) as P source); T<sub>6</sub> and T<sub>7</sub>, 100 and 75% NPK- Nutripellet (Single super phosphate (SSP) as P source). The results of the experiment indicated the 100% NPK Nutripellet recorded the highest flower yield of 45.5 t ha<sup>-1</sup> which was 98.8% higher than surface broadcast. On an average, Nutripellet with DAP recorded flower weight, petal-calyx ratio, and number of petals per flower. The advantages of root zone placement of Nutripellet were one time placement at transplanting, no top dressing of fertilizers and slow release of nutrients expected throughout the crop period.

**Key words:** Deep placement, fertilizer, flower yield.

### INTRODUCTION

African marigold (*Tagetes erecta* L.) is an important traditional flower crop and constitutes one of the five most commonly cultivated and used flowers in urban and rural India. They are extensively used for making garlands, beautification, religious offerings, social functions and other purposes namely pigment and oil extraction besides therapeutic uses. Apart from these uses, marigold is widely grown in gardens and pots for display purpose. It is a highly suitable bedding plant and also ideal for newly planted shrubberies to provide colour and to fill up the space. It has a great economic potential in loose flower trade. It gains popularity among garden

lovers and loose flower dealers on account of its free flowering habit, short duration, attractive colour, shape and keeping quality. The crop also finds industrial application in several areas like preparation of natural dyes and essential oils. It is used as mosquito and nematode repellents. It is also used as a feed additive for poultry industry (Bose and Yadav, 1993).

Nutripellet technique implements the benefits of integrated nutrient management and deep placement in the root zone of crops. On placement in soil, each Nutripellet is expected to give continuous nutrient support to the crop in the rhizosphere region.

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Its promising effects have been successfully evaluated under surface irrigation and drip irrigation (Radhika, 2008). Nutripellet is a packet in tubular form having several inputs viz., fertilizers, manures, pesticides and bioinoculants. By this composition, it is possible to place NPK fertilizers, manure and bioinoculants just below the plant or by the side of plant at the time of transplanting, so that nutrients are efficiently utilized by crop in the active root zone. This technique was first developed and tested for rice in pot study with  $^{15}\text{N}$  tracer using Nutriseed Pack having seed and fertilizer. The results showed 57.1% of fertilizer N recovery, which exceeded two folds of recovery noted for surface broadcast, with a grain yield increase to the tune of 81.8% over conventional surface broadcast (Asha and Arulmozhiselvan, 2006).

Deivanai (2005) and Arulmozhiselvan et al. (2009) recorded remarkable yield increase in rice with the Nutriseed Pack technique. Vengatesan (2007) has conducted experiment with Nutriseed Packs consisting seed, manure and fertilizer. Pellets of Nutriseed Pack placement increased maize yield to the tune of 56% over surface application of straight fertilizers. With this background, attempt was made with different levels of nutrients in Nutripellet under surface irrigation condition for marigold yield and its components.

## MATERIALS AND METHODS

### Preparation of Nutripellets

The fertilizer nutrient dose generally adopted for carnation in many parts of India is 90:75:75 kg NPK/ha. In this study, the fertilizers (in the form of urea, single super phosphate (SSP) or diammonium phosphate (DAP) and muriate of potash) needed to supply 100 or 75% of N, P and K as per treatment for a single marigold plant were taken and placed in the pelleting device and 30 mm long fertilizer pellets were formed. Then the pellets were encapsulated by placing in a degradable polyester coated paper pouch and sealing with hot flat wire. For preparing manure pellet, enriched vermicompost was used. For this purpose 10 kg of vermicompost was enriched with 1 kg of single super phosphate and incubated for 30 days with adequate moisture. At the end of the period, the enriched manure was pelleted in the pelleting machine. Each manure pellet weighed about 3 g. Bioinoculants viz., Azospirillum (mixture of *Azospirillum* and Phosphobacteria), *Trichoderma* were also mixed with vermicompost and kept in powder form.

Each Nutripellet was constructed by combining fertilizer and manure pellets on a 10 x 10 cm newspaper by placing one over other and then wrapping as a roll. First the encapsulated fertilizer pellet was placed, coinciding to the bottom edge. Over the fertilizer pellet, the manure pellet was placed. Then, one end of paper was flipped over the pellets and then folded as a roll. In the top cavity, about 0.5 g of bioinoculant mixture was added. Finally, the top of Nutripellet was closed with adhesive, then air dried and stored in cartons. The roll wrap which contained fertilizer pellet at bottom, manure pellet in the middle and bioinoculant on top, in total, is called as Nutripellet.

### Field experiment

In order to evaluate the effect of levels of nutrients in Nutri-Packs, a field experiment was conducted with the test crop of marigold under

surface irrigation. The field experiment was conducted in Farmer field, Puliampatti, Coimbatore during 2012 -13. The field was well ploughed, leveled and raised beds (20 cm) and channel space (35 cm) were formed alternatively. The field was divided into plots of 40 square meters in randomized block design. The experimental field experiences semiarid climate with dry summer extending from March to August. The mean annual rainfall is 893 mm, out of which 39.8% is distributed during South West Monsoon, 42% during North East Monsoon, 2.1% during winter and 16.1% during summer. The daily maximum and minimum temperature ranges at 33.5 and 25.3°C during South West Monsoon, 30.9 and 21.1°C during North East Monsoon, 30.9 and 20.8°C during winter and 36.4 and 24.7°C during summer, respectively.

Sowing of African marigold seeds in pro trays was done at 1 seed per cell. The seeds placed in the trays were covered with cocopeat and the trays were kept one above the other and covered with a polythene sheet till germination. After four days, the germinated pro trays were individually placed on the raised beds inside the shade net. Watering was done using rose can every day (twice/day) until seed germination. 19:19:19 + 0.5% ferrous sulphate and 0.5% manganese sulphate solution were drenched using rose can at 15 days after sowing. Twenty days old seedlings were transplanted in the mainfield during evening hours. Planting was done at a spacing of 60 x 45 cm. Gap filling was done at 5<sup>th</sup> day after transplanting. The treatments details are as follow T<sub>1</sub>, Control; T<sub>2</sub>, 100% NPK - surface application of fertilizers; T<sub>3</sub>-75%, NPK - surface application of fertilizers; T<sub>4</sub> and T<sub>5</sub>, 100 and 75% NPK- Nutripellet (DAP as P source); T<sub>6</sub> and T<sub>7</sub> - 100 and 75% NPK- Nutripellet (SSP as P source). Recommended cultural practices (ploughing, irrigation, weeding and plant protection measures) were followed throughout the growing period. At harvest yield parameters (petal calyx ratio, number of harvest or picking, flower diameter, individual flower weight, number of flowers per plant and yield) were recorded.

### Statistical analysis

The growth, yield parameters and yield obtained in the study were subjected to statistical scrutiny by mean values with randomized block design.

## RESULTS AND DISCUSSION

### Initial characteristic of physico-chemical properties of soil

The soil of the experimental site was neutral in reaction, nonsaline and low in organic carbon (0.38%), with cation exchange capacity (CEC) of 17.7 cmol (p<sup>+</sup>) kg<sup>-1</sup> soil. The nutrient status of soil was low in available N (235 kg ha<sup>-1</sup>), P (8.96 kg ha<sup>-1</sup>) and high in K (727.1 kg ha<sup>-1</sup>). The status of available micronutrients was deficient, indicating DTPA-extractable content of 1.88 ppm for iron, 1.95 ppm for manganese, 0.59 ppm for zinc and 0.17 ppm for Copper.

### Yield and yield attributes at harvest

Nutrition of marigold crop by surface broadcast and Nutripellet placement tried in different levels has influenced yield (Table 1) and yield attributes (Table 2) of

**Table 1.** Yield (kg ha<sup>-1</sup>) at Harvest under Deep placement of fertilizer (Nutripellet).

Treatment	Flower yield per plant (kg)	Flower yield per hectare (tonnes)	% yield increase over control
T1 Control (No fertilizers)	0.361	22.9	-
T2 Broadcast application - 100% NPK	0.602	38.2	66.8
T3 Broadcast application - 75 % NPK	0.532	33.8	47.4
T4 Nutripellet with DAP - 100% NPK	0.717	45.5	98.8
T5 Nutripellet with DAP - 75 % NPK	0.593	37.6	64.4
T6 Nutripellet with SSP - 100% NPK	0.624	39.6	73.0
T7 Nutripellet with SSP - 75 % NPK	0.529	33.6	46.6
SEd	0.004	0.25	-
CD (5%)	0.009	0.54	-

**Table 2.** Yield attributes at harvest under deep placement fertilizer (Nutripellet).

Treatments	Petal - calyx ratio	Number of harvest (No. of picking)	Flower diameter (cm)	Number of flowers per plant
T1 Control (No fertilizers)	49.14	5.32	5.94	41.04
T2 Broadcast application - 100% NPK	48.65	7.95	6.35	47.45
T3 Broadcast application - 75 % NPK	48.21	7.87	6.14	44.72
T4 Nutripellet with DAP - 100% NPK	47.56	8.29	7.13	49.91
T5 Nutripellet with DAP - 75 % NPK	47.71	7.98	6.94	45.68
T6 Nutripellet with SSP - 100% NPK	47.60	8.16	7.04	47.06
T7 Nutripellet with SSP - 75 % NPK	47.93	7.94	6.89	43.54
SEd	0.021	0.036	0.017	0.103
Critical Difference (0.05)	0.046	0.080	0.037	0.224

marigold by exhibiting significant variations in yield and yield attribute parameters. The highest fresh flower yield (45.5 t ha<sup>-1</sup>) was achieved with Nutripellet Pack containing DAP as P source, followed by Nutripellet Pack containing SSP as P source. Comparing DAP and SSP sources, DAP is easily soluble and slow release of nutrients from Nutripellet. Under broadcast, the yield recorded (38.2 t ha<sup>-1</sup>) was moderate (Figure 1), and under control, very low yield (22.9 t ha<sup>-1</sup>) was recorded. The yield attained was higher under Nutripellet placement when compared to conventional surface broadcast of fertilizers due to the placement of Nutripellet pack brought out that added nutrients in slow state of release in Nutripellet Pack was sufficient to reach the maximum attainable yield of the marigold. The high flower yield recorded under Nutripellet Pack placement was 98.8% higher than surface broadcast (Farmers practice).

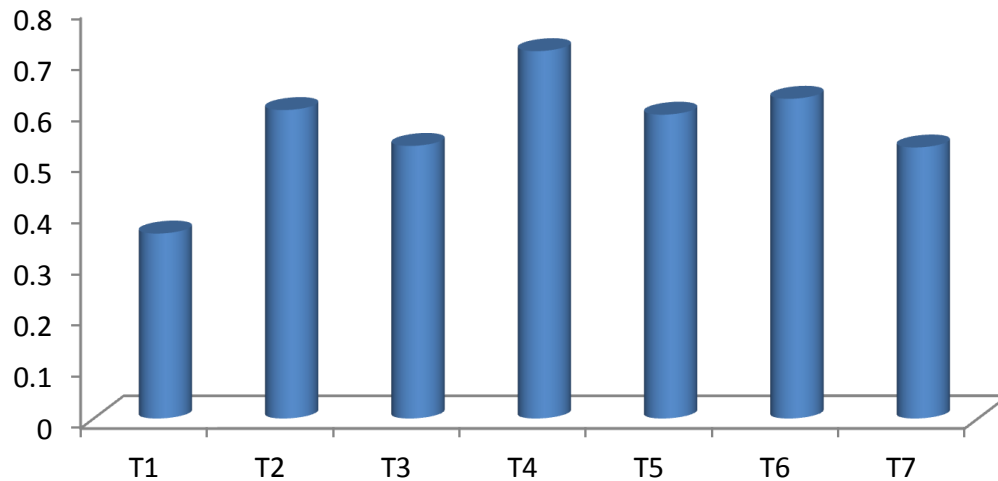
Chauhan et al. (2005) in marigold cv. Pusa Narangi Gainda, the application of vermicompost at 1000 g per square meter recorded higher yield of flowers (1757.76 g / square meter) compared to application of vermicompost at 500 g per square meter (1429.00 g/m<sup>2</sup>). Swapna (2010) recorded surface broadcast application of 100% NPK along with humic acid 0.2% as foliar spray recorded the highest value (41.50, 41.05 and 40.77) in

the first season, second season and pooled mean, respectively, for marigold cv. Among the treatments and control (conventional method of fertilizer application and irrigation), control exhibited lowest flower yield (31.35, 30.38 and 31.12) in the first season, second season and pooled mean, respectively.

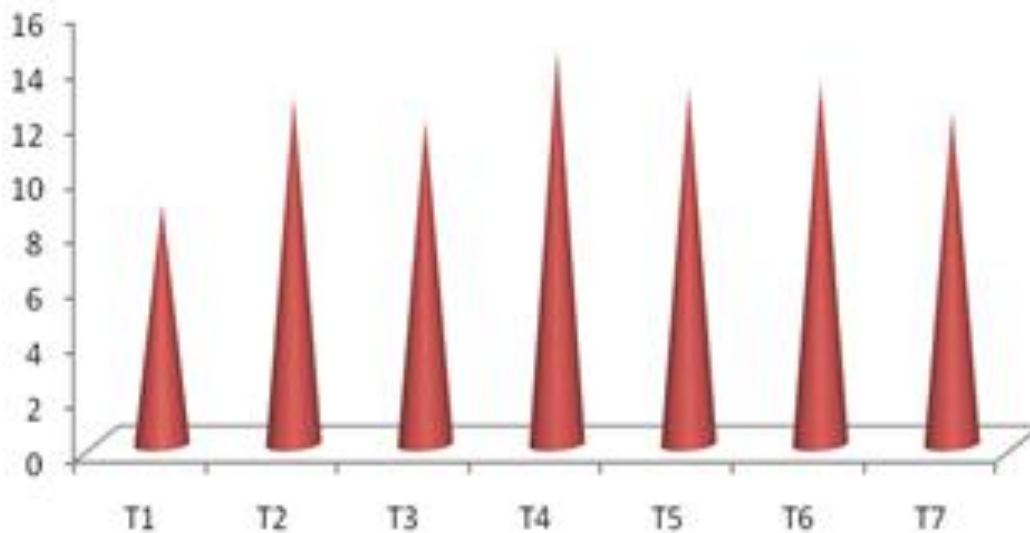
Nutripellet placement and surface broadcast application influenced the yield attributes (Table 2) are equally by recording petal calyx ratio from 47.56 - 49.14. The effect of nutrition was much pronounced in Nutripellet placement application showing the highest flower diameter (7.13 cm), number of flowers per plant (49.91), number of harvest or picking of flowers (8.29) and individual flower weight (Figure 2) (14.37 g). The yield attributes were poor under control.

The promising effect of Nutripellet pack would be attributed to the controlled release of fertilizers which were precisely placed within 5 cm distance from soil surface in the root zone of the crop. The fertilizer pellet positioned nearer to manure pellet of Nutripellet pack in combination would have remained as nutrient pile allowing mainly radial movement of N, P and K nutrients within the soil in root zone, as the pellet was fully covered by polycoat paper as an encapsulation, having diffusion area all around. The high status of available nutrients in

## Flower yield per plant (kg)



**Figure 1.** Effect of surface broadcast and Nutripellet placement on flower yield per plant.



**Figure 2.** Effect of surface broadcast and Nutripellet placement on individual flower weight.

deep placement throughout period of crop could be the evidence of the controlled release phenomenon. With higher nutrient availability and high nutrient uptake resulted under deep placement might have influenced yield and yield attributes of marigold.

### Conclusion

Marigold crop requires continuous supply of nutrients

since its vegetative as well as flowering stage. Effort made in the present study to maintain the constant nutrient support by Nutripellet placement was successful in achieving desired flower production with appreciable yield and quality. Among the two methods, the placement of Nutripellet was much convenient as it was one time placement at the time of transplanting and there after only irrigation was monitored. In surface broadcast method was done to distribute the nutrients erratic, low nutrient efficiency. Hence, Nutripellet placement could be

preferred for marigold, to save labour and reduce the fertilizer cost and increase yield and yield parameters of marigold.

**Abbreviations:** **SSP**, Single super phosphate; **DAP**, diammonium phosphate; **CEC**, cation exchange capacity.

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