International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 2651-2653

Received: 17-05-2018
Accepted: 20-06-2018

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Influence of integrated nutrient management on flower yield and economics of marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda

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Abstract
The study consist of integrated application of organic (FYM, Biofertilizers), recommended inorganic fertilizer (225:60:60 NPK/ha) and Micro nutrient foliar spray showed the significant influence on the growth, yield and quality of marigold cv. Pusa Basanti Gainda. Among the different treatment combinations, T_8 (100 % RDF + FYM + Arka Microbial Consortium+ VAM + Micro nutrient foliar spray) recorded the higher individual flower weight (9.92g), fresh weight of ten flowers (98.60g), dry weight of ten flowers (13.00 g), flower diameter (6.13cm). The maximum benefit cost ratio was obtained in 75 % RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray (T_9). Which recorded significantly highest flower yield ton per hectare (9.57 ton ha^{-1}), with a B: C ratio of 2:98 and minimum was recorded in control (T_1) which registered lowest flower yield ton per hectare (7.00 ton ha^{-1}) with a B: C ratio of 1:72 with respect to most of the treatments studied. The study concludes that significant influence of combined application of organic and inorganic fertilizers on African marigold to enhance the flowering yield and their characters.

Keywords: *Tagetes erecta* L., flower yield, B: C ratio, organic manures, bio-fertilizer and inorganic fertilizers

Introduction
Marigold (*Tagetes erecta* L.), which occupies a prominent place in ornamental horticulture, is one of the commercially exploited flower crops belonging to the family Asteraceae. It is grown as an annual in an herbaceous border and is also ideal as filler for newly planted shrubberies to provide colour and to fill the spaces. Flowers are commonly extensively used for decoration in various religious and social functions (Singh, 2006) [5]. The major components of integrated nutrient supply system are fertilizers, farm yard manures, Arka Microbial Consortium, VAM, Micro nutrient foliar spray etc. Therefore, the integrated use of nutrients is the need of the hour. The use of organic manures and bio-fertilizers along with the balanced use of chemical fertilizers is known to improve physico-chemical and biological properties of soil, besides improving the efficiency of applied fertilizers. It is a carrier based microbial product which contains N-fixing, P- solubilizing and plant growth promoting microbes (Scott *et al.*, 1999) [4]. It will considerably reduce the cost of cultivation besides the synergistic effects of combined microbes. These are less expensive and do not require non-renewable source of energy during their production. Integrated nutrient management in marigold is comparatively a new aspect of research.

Materials and Methods
The present investigation was carried out at the Department of Horticulture, University of Agricultural Sciences, Bengaluru during the year of 2014-2015. Geographically, Bengaluru is located at 12^0 $58^{|}$ N latitude, 77^0 $35^{|}$ E longitude and at an altitude of 930 meters above mean sea level. The soil at the experimental site comprised of red sandy loam with of pH of 5.86 and the electrical conductivity (EC) was 0.211 dSm^{-1}. The soil had a good water holding capacity.

Results and Discussion
Treatments of integrated nutrient management imparted significant effect on flower yield as presented in Table 1.

The higher flower yield is a manifestation of other yield contributing characters *viz.,* Flower diameter (6.13 cm), individual flower weight (9.92 g), fresh weight of ten flowers (98.60 g), dry weight of ten flowers (13.00 g). The treatment T_8 recorded maximum individual flower weight **(**9.92 g), however it was on par with T_9 (9.88 g) and which was significantly superior over all other treatments control (8.43 g). The treatment T_8 recorded maximum individual fresh flower weight (98.60 g), however it was at par with T_9 (98.14 g) and which was significantly superior over all other treatments control (84.67 g). The treatment T_8 recorded maximum dry weight of ten flowers (13.00 g), however it was on par with T_9 (13.00) and which was significantly superior over all other treatments control (10.00 g). Hence, the increase in individual flower, fresh flower, dry flower weight and flower diameter in those treatments might be due to the effect of balanced nutrition supplied through the combined application of Arka Microbial Consortium, FYM and Micro nutrient foliar spray and along with 100 per cent RDF. Thus, the higher flower yield per hectare was obtained in treatment T_8 however, it was on par with T_9 Similar findings were obtained by (Rajanna, 2001) [3] in China aster.

In marigold large sized flowers are preferred. The treatments had a significant influence on this character at different levels. The flower diameter was maximum in plants treated with RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray (T_8) and 75 % RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray (T_9) compared to other treatments. This may be due to early breaking of apical dominance followed by easy and better translocation of nutrients to the flowers brought about by inoculation with beneficial microbial inoculants like microbial consortium (*Azospirillum* PSB along plant growth promoting substances). The positive effect of vermicompost on flower diameter has been reported earlier in marigold by Mashaldi, (2000) [2].

There was significant difference in shelf life of flowers as influenced by different treatments. The maximum shelf life (9.70 days.) of flowers was recorded in T_8 (RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray), however it was on par with T_9 (75 % RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray) (9.54 days).Which might be due to the higher retention of water in the cells of flowers and lower desiccation, whereas, in control (RDF + FYM) lesser shelf life (4.70 days) was noticed in room condition. Similar beneficial effects of bio-fertilizers and vermicompost on shelf life have been reported by Anuradha *et al.,* (1990) [9] and Mashaldi, (2000) [2] in marigold.

The benefit to cost ratio differed significantly among the treatments the data is presented in Table 2. Benefit cost ratio is an important and ultimate factor which decides the optimum levels of input to be used for maximization of production and returns from any crop. In the preset study, the maximum benefit cost ratio was obtained in 75 % RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray (T_9). Which recorded significantly highest flower yield ton per hectare (9.57 ton ha^{-1}), with a B: C ratio of 2:98 and minimum was recorded in control (T_1) which registered lowest flower yield ton per hectare (7.00 ton ha^{-1}) with a B: C ratio of 1:72 with respect to most of the treatments studied. Thus it could be recommended in future. Application of bio-fertilizers with organic manure further increased the nutrient use efficiency which resulted in higher net return and benefit: cost ratio. The present result is in conformity with the research finding of Verma (2010) [6] in chrysanthemum.

Table 1: Flower diameter, individual flower weight, fresh weight of ten flowers, Shelf life and dry weight of ten flowers as influenced by Integrated Nutrient Management in African marigold cv. Pusa Basanti Gainda

Treatments	Individual flower weight (g)	Fresh weight of ten flowers (g)	Flower diameter (cm)	Shelf life (days)	Dry weight of ten flowers (mg)
T_1-RDF + FYM (Control)	8.43	84.67	5.28	4.70	10.00
T_2-RDF +FYM + Arka Microbial Consortium	8.71	89.07	5.31	5.70	11.00
T_3-RDF + FYM + VAM	8.77	91.40	5.46	6.00	11.00
T_4-RDF+ FYM+ Arka Microbial Consortium +VAM	9.00	88.60	5.45	6.30	11.00
T_5-75% RDF +FYM+ Arka Microbial Consortium	9.15	91.53	5.47	6.30	12.00
T_6-75% RDF +FYM+ VAM	9.80	97.98	5.56	9.00	12.00
T_7-75% RDF+ FYM+ Arka Microbial Consortium + VAM	8.95	90.00	5.43	6.30	10.00
T_8-RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray	9.92	98.60	6.13	9.70	13.00
T_9-75% RDF+ FYM+ Arka Microbial Consortium + VAM + Micro nutrient foliar spray	9.88	98.14	6.10	9.54	13.00
Mean	9.17	92.22	5.57	7.06	11.44
S.Em±	0.01	0.17	0.01	0.06	0.03
CD (0.05)	0.04*	0.51*	0.03*	0.19*	0.11*

RDF- Recommended Dose of Fertilizer (225:60:60 kg NPK/ ha) **VAM** - 675 g/ ha
Micronutrient foliar spray – 2.5kg/ha **FYM** - 20 tons/ ha
Arka Microbial Consortium- 12.5kg/ ha *** Significant**

Table 2: Benefit: Cost ratio as influenced by Integrated Nutrient Management of African marigold cv. Pusa Basanti Gainda

Treatment	Flower yield (tons/ha)	Total cost of cultivation (Rs)	Gross return (Rs)	Net return (Rs)	B:C ratio
T_1-RDF + FYM (Control)	7.00	121991	210000	88009	1.72
T_2-RDF +FYM + Arka Microbial Consortium	7.70	122928	231000	108072	1.87
T_3-RDF + FYM + VAM	7.80	122071	234000	111929	1.91
T_4-RDF+ FYM+ Arka Microbial Consortium +VAM	7.40	123008	222000	98992	1.80
T_5-75% RDF +FYM+ Arka Microbial Consortium	8.40	95996	252000	156004	2.62

T_6-75% RDF +FYM+ VAM	8.40	95353	252000	156647	2.64
T_7-75% RDF+ FYM+ Arka Microbial Consortium + VAM	8.30	96056	249000	152944	2.59
T_8-RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray	9.60	123383	288000	164617	2.33
T_9-75% RDF+ FYM+ Arka Microbial Consortium + VAM + Micro nutrient foliar spray	9.57	96337	287340	191003	2.98

RDF- Recommended Dose of Fertilizer (225:60:60 kg NPK/ ha) **VAM** - 675 g/ ha
Micronutrient foliar spray – 2.5kg/ha **FYM** - 20 tons/ ha
Arka Microbial Consortium- 12.5kg/ ha **Marigold – Rs.** 30/kg

Conclusion

The treatment combination of 75 per cent RDF + FYM + Arka Microbial Consortium + VAM + Micro nutrient foliar spray (T_9) realized maximum net returns of Rs. 1,19,003 per ha with a benefit: cost ratio of 2:98. Result have clear indicate cost of fertilizer save to have extant ends of 19.04 without any significant change in the flower yields of marigold. Therefore, it may be concluded that the use of 75 per cent RDF, FYM, Arka Microbial Consortium, VAM, Micro nutrient foliar spray (T_9) helped in getting better plant growth, higher quality, flower yield of African marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda with higher returns.

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