International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 1674-1678

Received: 18-05-2018
Accepted: 20-06-2018

Kurakula Divya
M.Sc. (Hort.) Floriculture and Landscape Architecture, Sri Konda Laxman Telangana State Horticultural University, Telangana, India

A Girwani
Associate Dean (Horticulture), College of Horticulture, Mojerla, Telangana, India

D Vijaya
Senior Scientist (Soil Science), Grape Research Station, Rajendranagar, Delhi, India

P Prasanth
Senior Scientist & Head (Hort.), Floricultural Research Station, Rajendranagar, Delhi, India

Correspondence
Kurakula Divya
M.Sc. (Hort.) Floriculture and Landscape Architecture, Sri Konda Laxman Telangana State Horticultural University, Telangana, India

Influence of levels of fertigation and sources of nutrients on flowering and yield characters of marigold (*Tagetes erecta* L.) CV. pusa Narangi Gainda

Kurakula Divya, A Girwani, D Vijaya and P Prasanth

Abstract
The experiment on marigold was conducted to study the optimum dose of fertigation in marigold using fertilizers from different sources on flowering and yield characters of marigold cv. Pusa Narangi Gainda grown under open conditions. The experiment was laid out in Randomized block design (RBD) with seven treatments. The results indicated significant difference among the treatments with respect to flower quality and yield. Application of 75% of recommended dose of fertilizers (RDF) in water soluble form (WSF) promoted maximum number of flowers per plant, flower yield per plant and flower yield per hectare (14.42 t) in addition the flower diameter and flower weight also were maximum. Further, the benefit cost ratio was also maximum (2.10) with the application of 75 per cent of RDF with WSF in marigold cultivated under open conditions.

Keywords: Marigold, fertigation, water soluble fertilizers, shelf life

Introduction
Marigold (*Tagetes erecta* L.), a member of the family Asteraceae, is a traditional flower that is gaining popularity on account of its easy cultivation, wide adoptability to different soil and climatic conditions. The plants with their attractive flower colour, blooms for a considerably long period and the flowers remain fresh for quite a long time after plucking from the plant. All these factors have made marigold as one of the most popular flowers in India.

Under commercial cultivation of marigold, inadequate plant nutrition is leading to several nutritional disorders which eventually lead to decline of plant vigour and ultimately reduction of yield.

In recent times fertigation has proved to be the most economical fertilizer application technique for most of the flower crops and has potential for more accurate and timely crop nutrition leading to increased yields, enhanced quality and early crop maturity. Fertigation is also found to reduce the wastage of nutrients through enhanced fertilizer use efficiency, besides providing flexibility in timing of fertilizer application in relation to crop demand based on physiological stages of growth (Papadopoulos, 1992). It also helps in economizing the use of water and fertilizers and reduce the cost of cultivation by reducing the cost of water, fertilizers, labour and energy (Khan *et al*., 1997).

Hence, optimum level of fertilizer dosages through fertigation is required for improving the fertilizer use efficiency in marigold. In view of above facts the experiment was conducted to study the influence of different levels of fertigation and sources of nutrients in marigold cv. Pusa Narangi Gainda.

Material and Methods
The experiment was conducted during the year 2016 -17 to study the effect of levels of fertigation on vegetative and flowering characters of marigold cv. Pusa Narangi Gainda grown under open conditions at Floricultural Research Station, Rajendranagar, Hyderabad during Rabi season.

The soil at the experiment site was red sandy loam soil with a pH of 7.38 and EC of 0.33. The experiment was laid out in Randomized Block Design (RBD) comprising seven treatments with three replications.

The treatments consists of T_1: 75% of RDF with Water soluble fertilizers (WSF), T_2: 100% of RDF with WSF, T_3: 125% of RDF with WSF, T_4: 75% of RDF as WSF + 25 % of RDF as straight fertilizers (SF), T_5: 50% of RDF as WSF + 50% of RDF as SF, T_6: 25% of RDF as WSF + 75% of RDF as SF, T_7: 100% of RDF as SF (control). Recommended dose of fertilizers ha^{-1} for SF was 90: 90: 75 kg of NPK ha^{-1} and water soluble fertilizers ha^{-1} per hectare was 90: 22.5*: 75 kg of NPK (*25% WSF (22.5 kg/ha) was applied through fertigation remaining 75 % RDF (69.5 kg/ha) was applied as single super phosphate as basal dose). At last ploughing 20 tonnes of Farm yard manure and 422 kilo grams of Single super phosphate (75% RDF) were applied as basal, along with this each 2 kilo grams of *Azospirillum*, 2.5 kilograms of *Pseudomonas fluorescens* and *Phospho bacteria* were mixed with 50 kg of FYM per hectare and were applied uniformly for all the treatments.

The drip irrigation system and venturi injector fertigation unit were installed as per the experimental layout and treatment plan. Twenty five days old healthy and uniform seedlings were transplanted in the main field in double row system of planting at four leaf stage with a spacing of 60 cm between the rows and 30 cm between the plants. Water soluble fertilizers and straight fertilizers were applied as per the treatment combinations. Fertigation was given twice a week as per the plant growth stage. Observations were recorded on flowering and yield parameters in different treatments. The data collected were subjected to statistical analysis as per Panse and Sukhatme (1978).

Results and Discussion

The data pertaining to flowering and yield of marigold cv. Pusa Narangi Gainda are presented in Tables 1 and 2 respectively.

Significant differences were observed in number of days to first flower bud initiation due to various fertigation levels in marigold. Among the different fertigation levels tested, application of 75 per cent of RDF with WSF has significantly reduced the number of days taken to first flower bud initiation (29.12 DAT) and this might be attributed to reduced dose of N which in turn resulted in earliness of all the flowering characters. Similarly, there were significant difference in the days taken for full bloom after transplanting in marigold with different levels of fertigation and minimum days for full bloom (41.07 days) was recorded with the application of 75 per cent of RDF with WSF in marigold. On contrary application of higher doses of fertilizers in water soluble form (125% RDF in WSF) resulted in more vegetative growth rather than flowering, thus resulted in delay in flower blooming in marigold. Similar results were earlier reported by Ganesh *et al*. (2014) in chrysanthemum and Shashidhar (2004) in tuberose.

Increase in the number of flowers per plant is desirable character as it enhances the ultimate yield and net returns of the crop. The results indicated that application of 75 per cent of RDF using WSF recorded maximum number of flowers per plant (23.50 flowers) in cv. Pusa Narangi gainda. This was attributed to higher uptake of phosphorous and potassium at level which might have increased growth and metabolic transport that lead to proper vegetative growth and ultimately increased flower yield while excess application of fertilizers (more than recommended *i.e.*125%)) has given negative response. These results are in conformity with the earlier findings of Thamara *et al*. (2010) in China aster.

Consumers generally prefer uniform and big sized marigold flowers for garland making and decoration purpose. The results revealed that the fertigation at various concentrations had significantly influenced diameter of marigold flower, pedicle length and fresh weight of flower. Application of 75 per cent RDF as WSF recorded maximum flower diameter (4.58 cm), pedicle length (4.23 cm) and fresh weight of flower (6.27g). This may be attributed to higher nitrogen uptake which resulted in higher photosynthetic rate with more accumulation of metabolites leading to increased flower size, flower weight and pedicle length. Similar findings were earlier reported by Palanisamy *et al*. (2015), Zehra Salma *et al*. (2014) in Gerbera and Vijay Kumar *et al*. (2010) in China aster.

The data revealed that the flower yield per plant was significantly influenced by levels of fertigation. Application of 75 per cent of RDF using WSF recorded maximum flower yield per plant (194.57 g) and it was attributed to application of optimum dose of fertigation directly to the active root zone which might have increased fertilizer use efficiency and in turn reduced fertilizer rate without lowering the yield. While, there was reduction in flower yield at higher level of nitrogen (125% RDF) might be attributed to delayed onset of reproductive phase, leading to less number of flowers and flower yield. Similar results were earlier reported by Suresh (2015) and Sujatha *et al*. (2002) in gerbera.

Similarly the fertigation at various concentrations has significant influence on flower yield $plot^{-1}$ and flower yield per hectare of marigold. The maximum flower yield $plot^{-1}$ (23.37 kg) and flower yield per hectare (14.42 t) was obtained with 75 per cent of RDF with WSF. In the present study increase in yield may be due to the continuous supply of optimum dose of water soluble fertilizers in available form through fertigation at critical stages of plant growth. This might have resulted in higher uptake and better translocation of assimilates from source to sink which in turn increased the yield. The results obtained are in accordance with the findings of Gopinath and Chandra Shekar (2009) in carnation, and Shrikant *et al.* (2014) in gerbera.

Maximum longevity of flowers on plant was obtained with the application of 75 per cent of RDF using WSF (5.40 days) and this was statistically on par fertigation with 25 per cent of RDF as WSF + 75 per cent of RDF as SF (5.13 days- T_6) and minimum shelf life of flowers (3.93 days) was recorded in T_5 (50% of RDF as WSF + 50% of RDF as SF). While shelf life of flowers exhibited decreasing trend with increasing the levels of nitrogen. This may be due to the reason that higher dose of nitrogen resulted in higher and faster respiration and dehydration (Anuradha *et al*., 1990). These results are in accordance with the previous findings of Shrikant *et al*. (2014) in gerbera who reported significant difference in longevity of flower on plant with different levels of fertigation.

Application of 75 per cent of RDF as WSF recorded maximum vase life of flowers (6.40 days) and flower longevity on plant (5.40 days). The extended vase life of flowers in fertigation may be due to higher potassium supplied at later stages of crop growth which in turn influenced the sugar uptake to enhance vase life as suggested by Krishnappa and Reddy (2004). Further among all the fertigation treatments, maximum net returns and benefit cost ratio (2.10 respectively) was recorded with the application of 75 per cent of RDF with WSF compared to all other fertigation treatments.

From the above results, it can be concluded that the application of fertilizers at 75per cent of recommended dose of fertilizers in water soluble form through drip irrigation was found to be most optimal dose for increasing yield in marigold cv. Pusa Naragi gainda during rabi season and may be recommended for marigold cultivation.

Table 1: Effect of levels of fertigation on flowering characters of marigold cv. Pusa Narangi Gainda.

Treatments	First flower bud initiation (day)	Days taken for full bloom	No. of flowers plant^{-1}	Flower diameter (cm)	Length of flower pedicel (cm)	Fresh wt of flower (g)
T_1	29.12	41.07	23.50	5.58	4.23	8.41
T_2	31.60	42.37	17.18	5.35	3.73	7.55
T_3	32.26	43.27	16.48	5.26	3.70	7.49
T_4	31.35	42.27	18.27	5.37	3.74	7.81
T_5	32.20	42.33	16.98	5.27	3.59	7.53
T_6	30.90	41.77	20.67	5.54	4.15	8.27
T_7	31.33	41.80	20.24	5.40	3.98	8.08
S. Em ±	0.57	0.34	1.02	0.06	0.09	0.07
CD (P= 0.05)	1.78	1.04	3.18	0.17	0.27	0.21

T_1: 75% of RDF with WSF
T_2: 100% of RDF with WSF
T_3: 125% of RDF with WSF
T_4: 75% of RDF as WSF + 25 % of RDF as SF
T_5: 50% of RDF as WSF + 50% of RDF as SF
T_6: 25% of RDF as WSF + 75% of RDF as SF
T_7: 100% of RDF as SF (control)

Table 2: Effect of levels of fertigation on yield and storage life of marigold flowers cv. Pusa Narangi Gainda.

Treatments	Flower Yield (g plant^{-1})	Flower yield (kg plot^{-1})	Flower yield (t ha^{-1})	Flower longevity on plant (day)	Vase life of cut flowers (day)
T_1 : 75% of RDF using WSF	194.57	23.37	14.42	5.40	6.40
T_2 : 100% of RDF using WSF	159.67	20.74	12.80	4.53	5.02
T_3 : 125% of RDF using WSF	156.17	19.37	11.96	4.27	4.71
T_4 : 75% of RDF as WSF + 25 % of RDF as SF	160.61	20.63	12.73	4.67	5.25
T_5 : 50% of RDF as WSF + 50% of RDF as SF	159.13	20.69	12.77	4.13	4.88
T_6 : 25% of RDF as WSF + 75% of RDF as SF	192.37	22.84	14.28	5.13	6.25
T_7 : 100% straight fertilizers (Control)	190.73	22.82	14.23	5.05	5.11
S. Em (±)	0.88	0.25	0.07	0.13	0.35
CD (P = 0.05)	2.73	0.78	0.20	0.42	1.10

T_1: 75% of RDF with WSF
T_2: 100% of RDF with WSF
T_3: 125% of RDF with WSF
T_4: 75% of RDF as WSF + 25 % of RDF as SF
T_5: 50% of RDF as WSF + 50% of RDF as SF
T_6: 25% of RDF as WSF + 75% of RDF as SF
T_7: 100% of RDF as SF (control)

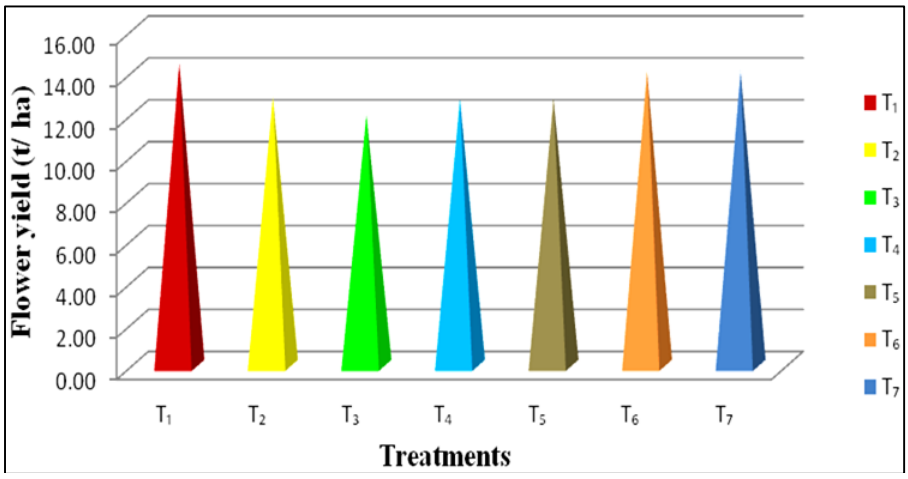
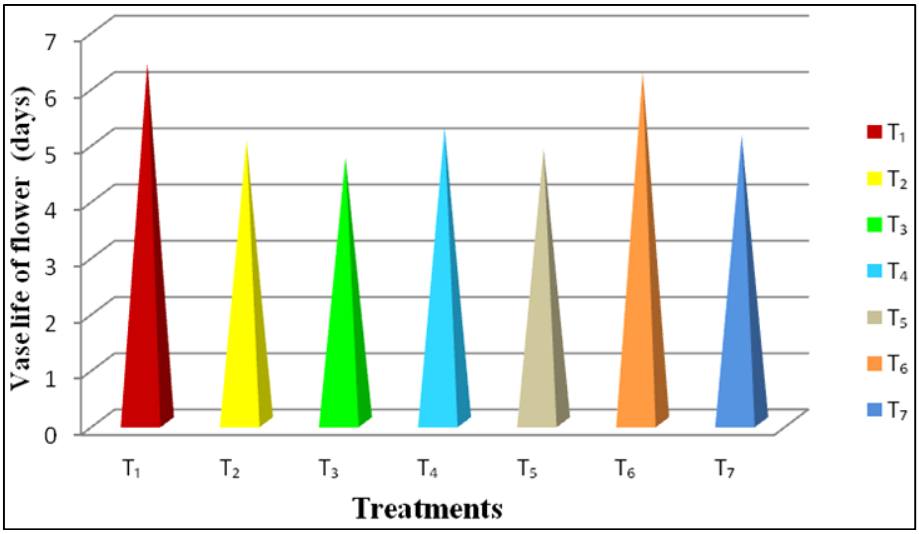
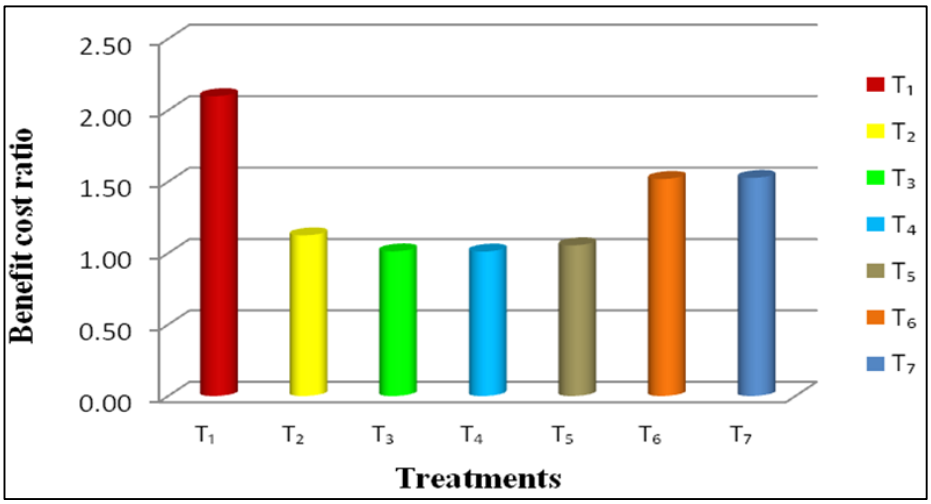


Fig 1: Effect of levels of fertigation on marigold flower yield per hectare (t ha^{-1}).



*T_1 - 75% of RDF using WSF, T_2 - 100% of RDF using WSF, T_3 - 125% of RDF using WSF, T_4 - 75% of RDF as WSF + 25 % of RDF as SF, T_5 - 50% of RDF as WSF + 50% of RDF as SF, T_6 - 25% of RDF as WSF + 75% of RDF as SF, T_7 - 100% of RDF as SF (control)

Fig 2: Effect of levels of fertigation on vase life of marigold flower stored in distilled water (day).



T_1 - 75% of RDF using WSF, T_2 - 100% of RDF using WSF, T_3 - 125% of RDF using WSF, T_4 - 75% of RDF as WSF + 25 % of RDF as SF, T_5 - 50% of RDF as WSF + 50% of RDF as SF, T_6 - 25% of RDF as WSF + 75% of RDF as SF, T_7 - 100% of RDF as SF (control).

Fig 3: Effect of different levels of fertigation on benefit cost ratio of marigold cultivation.

References

1. Ganesh S, Kannan M, Jawaharlal M. Optimization of fertigation schedule for cut chrysanthemum (*Dendranthema grandiflora* Tzvelev). Hort Flora Research Spectrum. 2014; 3(4):344-348.
2. Gopinath G, Chandrashekar SY. Yield of carnation as influenced by levels of fertigation and sources of nutrients of growing standard carnation cv. Trendy under cost greenhouse. Journal of Ornamental Horticulture. 2009; 12(4):251-255.
3. Khan MM, Shyamalamma S, Krishna manohar R. Relevance of green house technology in India. In: Progressive floriculture. The house of Sarpan, Banglore, 1997, 1-6.
4. Krishnappa KS, Reddy NS. Effect of cultivars, fertigation levels and floral preservatives in extending vase life of carnation cut flowers. Mysore Journal of Agricultural Sciences. 2004; 38(3):314-318.
5. Palanisamy Kannan D, Sharma R, Siddharth SB, Abhay Singh. Fertigation studies on gerbera (*Gerbera jamesonii* bolus ex hooker F.) for growth and yield under cover in southern hills (Shevaroy). National academy of agricultural science. 2015; 33(1):31-36.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi. 1978, 1-317.
7. Papadopoulos I. Phosphate fertigation of trickle-irrigated potato. Fertil Res. 1992; 31:9-13.
8. Shashidhar H. Effect of different levels of fertigation on growth and yield of tuberose (*Polianthes tuberosa* L.) hybrids. M.Sc. (Hort.) Thesis. University of Agricultural Sciences. Bangalore. Karnataka (India), 2004.
9. Shrikant M, Jawaharlal M. Effect of fertigation level and biostimulants on quality parameters of Gerbera var. Debora under polyhouse conditions. Trends in Bio sciences. 2014; 7(11):1134-1137.
10. Sujatha K, Narayana Gowda JV, Khan MM. Effect of different fertigation levels on gerbera under low cost greenhouse. Journal of Ornamental Horticulture. 2002; 5(1):54-59.
11. Suresh N. Effect of fertigation with water soluble macro nutrients and spraying of chelated micro nutrients on

growth, yield and vase life of gerbera (*Gerbera jamesonii* Bolus ex. Hook.) under saline water conditions of polyhouse. M.Sc. (Horti.) Thesis. Dr. Y.S.R. Horticultural University. Andhra Pradesh (India), 2015.
12. Thamara MP, Kumar DP, Ratnayake UAJ, Jayaprasad KV, Krishna manohar R. Effect of fertigation on flower yield and quality of china aster *Callistephus chinensis* (L.) Nees under open condition. Mysore J Agi. Sci. 2010; 44(1):39-43.
13. Vijaykumar NS, Gopinath G, Krishna manohar R. Growth, flowering and post harvest life of China aster as influenced by drip irrigation and fertigation. Mysore J Agri. Sci. 2010; 44(2):326-331.
14. Zehra Salma, Pratap M, Rao AM. Effect of different fertigation levels on growth, quality, yield and vase life of gerbera cultivars grown under polyhouse. Annals of Biology. 2014; 30(1):186-188.