



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(6): 1145-1148
© 2021 TPI

www.thepharmajournal.com

Received: 17-03-2021

Accepted: 23-04-2021

Laxmi Kant

Research Scholar, Department of Floriculture and Landscape, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Ashok Kumar

Associate Professor & Head, Department of Floriculture and Landscape, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Nishakant Maurya

Ph.D. Scholar, Department of Vegetable Science, College of Horticulture and Forestry, ANDUAT Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:

Laxmi Kant

Research Scholar, Department of Floriculture and Landscape, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Effect of integrated nutrient management on vegetative growth and flowering of African marigold (*Tagetes erecta* L.) Cv. Bidhan Marigold-2

Laxmi Kant, Ashok Kumar and Nishakant Maurya

Abstract

A field experiment was carried out to study the effect of integrated nutrient management on vegetative growth and flowering of African marigold (*Tagetes erecta* L.) Cv. Bidhan Marigold-2 at Main Experimental Station, Department of Floriculture and Landscape, Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) during the summer season of 2018-19 and 2019-20. The experiment was laid out in Randomized Block Design with 16 treatment combinations replicated thrice to assess the effect of *Azospirillum*, PSB, FYM, Vermi-compost, Poultry manure and NPK (Recommend Dose of Fertilizers).

Results reveal that the application of *Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml + Vermi compost @ 50 q/ha + 50% NPK (Recommend Dose of Fertilizers) left the significant response on vegetative growth and flowering of African marigold Cv. Bidhan Marigold-2. The treatment has resulted in maximum plant height, number of primary branches plant⁻¹, spread of plants, stem diameter at 30 days, earlier days to first bud initiation, days taken to flower bud opening, days taken to 50% flowering and maximum duration of flower in the field. Based on above results, it is concluded that the use of treatment combinations of *Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml + Vermicompost @ 50 q/ha + 50% NPK (Recommend Dose of Fertilizers) on African Marigold Cv. Bidhan Marigold-2 are beneficial for the growers of Eastern Uttar Pradesh.

Keywords: Marigold, *Tagetes erecta* L., nutrient management, *Azospirillum*, PSB, vermi-compost etc.

Introduction

African Marigold is an important commercial flower of India that belongs to the family Asteraceae (Composite). Marigold is a native of Central and South America especially Mexico. It also called 'Gainda' in the Hindi language. The genus *Tagetes* contain around 33 species, African marigold (*Tagetes erecta* L., 2n = 24) and French marigold (*Tagetes patula* L., 2n = 48) announced by (Rydberg, P. A., 1915) [8].

African marigold is one of the most important hardy flower crops which are grown commercially in different parts of the worlds. Marigold gained popularity among garden and flower dealers on account of its easy cultivation, wide adaptability of diverse soil and climatic conditions, the habit of profuse flowering, short duration to produce marketable flowers, and good keeping quality. In India, it is one of the most commonly grown loose flowers and extensively used on religious and social functions, in one form or another.

Agriculture, which largely depends on continuous use of chemical fertilizer is not only a burden for the farmer's or growers but is also responsible for the depletion of soil fertility which often affects productivity. Hence, efficient and judicious use of chemical fertilizers along with organic manure is imperative not only for obtaining more yields per unit area on a sustainable basis but also to conserve the energy and to avoid the problem of environmental quality.

Bio-fertilizers are the products containing living cells of different types of microorganisms, which are capable of mobilizing nutritive elements from non-usable form to usable form through a biological process. Azotobacter and PSB are free-living bacteria that help in N₂ fixation and solubilizing phosphorus in the soil. Nitrogen is an important metabolic element for the growth and development of the plant. It is essentially considered as metabolic activities, the transformation of energy, essential for the metabolism of protein and other biochemical product such as nucleic acid, chlorophyll and protoplasm. Phosphorus is the essential component of protoplasm and chlorophyll which caused conversion of photosynthesis into phospholipids resulting in adequate vegetative growth of the plant.

Among the bio-fertilizers *Azospirillum* fix the atmospheric N₂ non-symbiotically whereas Phosphate Solubilizing Bacteria (PSB) is responsible for the increasing availability of fixed phosphorus. Phosphorus also plays an important role in energy transformation and various metabolic activities of plants. It helps in the basic reactions of photosynthesis. Potassium increases resistance in plants against drought, heat, frost and various diseases caused by fungi and nematodes. It also improves the colour, fragrance and increases the size and weight of the flowers (Tisdale *et al.*, 1995, Sunitha *et al.*, 2007 and Luthra *et al.*, 1983) ^[11, 10, 5].

FYM provides the required nutrients to the plants. It provides the vital macro elements such as N (0.5-1.0%), P₂O₅(0.4-0.8%) and K₂O (0.5-1.9%) apart from this and poultry manure provides the required nutrients to the plant. It provides the vital macro elements such as N (1.8-3.0%), P₂O₅ (1.4-1.8%) and K₂O (0.8-2.5%) apart from this and Vermicompost provide the required nutrients to the plants. It provides the vital macro elements such as N (1.49-2.0%), P₂O₅(0.97-1.5%) and K₂O (0.45-1.2%) apart from this, it contains plant growth parameter substances such as NAA, Cytokinin, Gibberellins etc. It also harbours beneficial micro-flora within it. Organic manure also supplies secondary and microelements such as Ca, Mg, Fe, Mo, Zn, Cu etc.

Materials and Methods

The present inspection titled “Integrated Nutrient Management in Marigold (*Tagetes erecta* L.)” cv. Bidhan Marigold-2 was carried out at Main Experimental Station Department of Floriculture and Landscape, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya 224229 (U.P.), India during the year 2018-19 and 2019-20 in summer season. The Experiment laid out in a randomized block design with three replications and 16 different treatment combinations of biofertilizers and nutrients to evaluate the effect on growth and flower yield of African marigold. 30 days old seedlings of African marigold, Bidhan Marigold-2 variety were transplanted at 30 X 30 cm in well-prepared seedbed size 1.8 m x 1.5 m in the month of April. The full dose of phosphorus through single superphosphate, potash through muriate of potash, vermin compost, poultry manure and farmyard manure were applied just before transplanting of seedlings according to the treatment combinations. The seedlings were dip with bio-fertilizers (*Azospirillum* and PSB) in the prepared solution for 30 minutes.

Observations were recorded on vegetative characters after 30 days after transplanting and flowering attribute at a different stage of plants. The obtained data had statistically analysed adopting procedure as given by Fisher and Yates (1949) ^[13].

Result and Discussion

Growth parameters

The statistical analysis of data (Table-1) revealed that the growth parameters were influenced significantly due to the various combinations of bio-fertilizers and integrated nutrient management during both years of the experiment. The perusal of the data reveals that the maximum plant height (31.24 and 32.35cm), number of primary branches plant⁻¹ (10.80 and 11.80), the spread of plants (22.00 and 21.82 cm²) and stem diameter of marigold (3.74 and 3.82cm) were observed under the application of T₁₅ (*Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml + Vermicompost @ 50 q/ha + 50% NPK (Recommend Dose of Fertilizers)) and it was found to be

significantly superior over all other treatments followed by T₁₄ (*Azospirillum* + PSB + FYM + 50% NPK (Recommend Dose of Fertilizers)) treatment. The minimum plant height, number of primary branches plant⁻¹, spread of plants and stem diameter of marigold was noticed in T₁ (100% NPK (Recommend Dose of Fertilizers)) during both the years 2018-19 and 2019-20 as well as in pooled mean basis. Results clearly show that the combined application of *Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml and Vermicompost @ 50 q/ha along with 50% NPK (Recommend Dose of Fertilizers) proved to be beneficial for the robust growth of plants as compared to other treatments. This might be due to nitrogen and phosphorus fertilization in the combination of bio-inoculants (*Azospirillum* + PSB) and vermicompost proved to be beneficial to fix the atmospheric nitrogen and solubilize fixed phosphorus in soil and it also secrete substances like auxin, which stimulate the plant metabolic activities and photosynthetic efficacy leading better growth and development of plants. Further *Azospirillum* and PSB might have facilitated the physiological process of the plant included indirectly activity cell division and cell elongation of plants. These results are in close conformity with the findings of Pushkar *et al.*, (2008) ^[6], Kumar *et al.* (2009) ^[14], Bhat *et al.*, (2010) ^[1], Hashemabadi *et al.*, (2012) ^[3] and Rolaniya *et al.*, (2017) ^[7] in African marigold.

Flowering parameters

The statistical analysis of data (Table-2) revealed that the flowering parameters showed significant responses to different treatments of integrated nutrient management. With respect to days to first bud initiation (days), days taken to flower bud opening (days), days taken to first flowering (days), days taken to 50% flowering and duration of flowering in the field. The application of *Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml + Vermicompost @ 50 q/ha + 50% NPK (Recommend Dose of Fertilizers) (T₁₅) recorded a minimum number of days were taken for days to first bud initiation (37.40 and 33.30), days taken to flower bud opening (46.00 and 36.52), days taken to first flowering (49.33 and 40.66), days taken to 50% flowering (50.00 and 50.00) and maximum duration of flower (18.24 and 18.41) followed by T₁₄ (*Azospirillum* + PSB + FYM + 50% NPK (Recommend Dose of Fertilizers)) treatment and longer days taken to first bud initiation, first flowering, 50% flowering and minimum duration of flowering obtained under the T₁ (100 % NPK (Recommend Dose of Fertilizers)) were observed during both years of experiments 2018-19 and 2019-20 as well as in pooled mean basis. Results clearly show that the combined application of *Azospirillum* @ 250 ml/ha + PSB @ 250/ha ml and Vermicompost @ 50 q/ha along with 50% NPK (Recommend Dose of Fertilizers) proved to be beneficial for the robust growth of plants as compared to other treatments.

This might be due to the advancement in the flowering attributes through the application of bio-fertilizers and nutrients may be the favourable response of bio-inoculation which proved the nutrients available to the plants by the edition of atmospheric nitrogen to the soil promoted the more vegetative growth and yield attributing parameter through stimulation of plant growth-promoting substances such as Auxins, gibberellins, vitamins and organic acid the conversion of photosynthesis into protein resulted on more production biomass. It also favours the induction of more flower primordial and development of flower buds, attributing to quality flower and higher flowers yield. A similar result

was also reported by Kumar *et al.* (2009) ^[14], Kumar and Kumar (2017) ^[15], Shaikh A. J. *et al.*, (2018) ^[9], Yadav *et al.*, (2018) ^[12], Kumari *et al.*, (2019) ^[4], Chaupoo and Kumar, (2020) in African marigold.

Table 1: Effect of integrated nutrient management on vegetative parameters of African marigold

S. N.	Treatments	Plant height (cm) 30days			No. of primary branches (30days)			Spread of plant (cm ²) 30 days			Stem diameter (cm) 30 days		
		2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	100% RDF	18.68	20.54	19.61	6.48	8.48	7.48	8.88	12.14	10.51	1.31	1.55	1.43
T ₂	Azo +75% RDF "N" +100% RDF "P" and K	22.14	22.92	22.53	7.51	8.51	8.01	9.17	13.20	11.19	1.46	1.73	1.60
T ₃	PSB + 75% RDF "P" + 100% RDF "N" and K	22.35	23.62	22.99	8.00	9.00	8.50	10.74	13.93	12.34	1.61	1.88	1.75
T ₄	FYM + 50% RDF	24.34	24.95	24.64	8.40	9.40	8.90	11.77	14.90	13.34	1.89	1.92	1.91
T ₅	VC + 50% RDF	25.68	25.92	25.80	7.68	9.12	8.40	12.91	15.83	14.37	2.17	2.36	2.27
T ₆	PM + 50% RDF	23.72	24.61	24.16	8.50	9.50	9.01	12.14	15.24	13.70	1.72	2.58	2.16
T ₇	Azo + FYM + 50% RDF	25.32	25.91	25.61	9.50	10.80	10.15	13.88	16.49	15.19	2.36	2.41	2.39
T ₈	Azo + PM + 50% RDF	24.34	25.74	25.04	9.34	10.28	9.81	14.70	16.72	15.72	2.44	2.49	2.47
T ₉	Azo+ VC + 50% RDF	24.40	25.14	24.77	9.52	10.52	10.03	15.77	17.95	16.86	2.69	2.72	2.71
T ₁₀	PSB + FYM + 50% RDF	26.19	27.08	26.64	9.60	10.60	10.10	16.77	17.77	17.27	2.83	2.83	2.83
T ₁₁	PSB + VC + 50% RDF	26.54	27.88	27.21	9.70	10.70	10.21	17.42	19.40	18.42	2.88	2.88	2.88
T ₁₂	PSB + PM + 50% RDF	27.22	28.45	27.83	10.35	11.35	10.85	17.83	20.78	19.31	2.92	2.95	2.94
T ₁₃	Azo + PSB + 50% RDF 'N' and 'P' + 100% RDF 'K'	28.29	29.63	28.96	10.53	11.53	11.04	18.94	20.86	19.91	2.97	2.97	2.97
T ₁₄	Azo+ PSB + FYM + 50% RDF	29.25	30.85	30.05	10.68	11.68	11.18	20.84	21.52	21.18	3.11	3.11	3.11
T ₁₅	Azo + PSB + VC + 50% RDF	31.24	32.35	31.80	10.80	11.80	11.31	21.62	22.00	21.82	3.74	3.82	3.78
T ₁₆	Azo + PSB + PM + 50% RDF	29.19	29.71	29.45	9.90	10.86	10.38	19.13	21.68	20.41	2.83	2.99	2.91
	SE (m) ±	0.24	0.36	0.30	0.15	0.16	0.16	0.17	0.67	0.43	0.11	0.07	0.09
	CD at 5%	0.70	1.07	0.88	0.46	0.46	0.46	0.51	1.96	1.24	0.33	0.20	0.27

Table 2: Effect of integrated nutrient management on flowering parameters of African marigold

S. N.	Treatments	Days to first bud initiation (days)			Days taken to flower bud opening (days)			Days taken to first flowering (days)			Days taken to 50% flowering			Duration of flowering in the field		
		2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	100% RDF	44.06	43.60	43.83	51.00	51.00	51.00	54.55	52.33	53.44	57.51	54.00	55.76	9.09	9.76	9.43
T ₂	Azo +75% RDF "N" +100% RDF "P" and K	43.83	43.46	43.65	50.10	50.10	50.10	53.82	52.10	52.96	56.19	53.33	54.76	9.44	10.15	9.80
T ₃	PSB + 75% RDF "P" + 100% RDF "N" and K	43.26	42.76	43.02	50.20	50.20	50.20	53.58	52.20	52.89	54.14	53.33	53.74	10.53	10.83	10.68
T ₄	FYM + 50% RDF	42.76	41.90	42.33	49.90	49.90	49.90	53.13	51.90	52.52	53.53	52.67	53.10	10.61	10.94	10.78
T ₅	VC + 50% RDF	41.83	41.66	41.75	48.63	48.63	48.63	50.96	50.96	50.97	53.10	52.33	52.72	12.58	11.46	12.03
T ₆	PM + 50% RDF	42.16	40.93	41.55	44.86	45.02	44.94	51.45	47.42	49.44	52.00	52.00	52.00	11.74	11.18	11.46
T ₇	Azo + FYM + 50% RDF	41.70	41.30	41.50	49.86	45.26	47.56	53.48	48.38	50.93	52.33	52.33	52.33	12.58	12.58	12.59
T ₈	Azo + PM + 50% RDF	41.43	41.08	41.26	49.76	45.22	47.49	53.22	49.16	51.20	51.66	51.67	51.67	12.73	13.23	12.98
T ₉	Azo+ VC + 50% RDF	41.53	40.55	41.04	49.50	43.56	46.53	52.74	46.49	49.62	51.66	51.66	51.67	13.47	14.80	14.14
T ₁₀	PSB + FYM + 50% RDF	41.10	38.53	39.82	49.06	41.81	45.44	51.81	45.31	48.56	51.33	51.33	51.33	13.39	14.90	14.15
T ₁₁	PSB + VC + 50% RDF	40.10	37.93	39.02	48.96	40.40	44.68	50.50	43.92	47.21	51.00	51.00	51.00	14.76	15.30	15.03
T ₁₂	PSB + PM + 50% RDF	40.36	36.43	38.40	48.36	39.36	43.86	50.36	42.38	46.38	50.66	50.66	50.67	15.41	15.62	15.52
T ₁₃	Azo + PSB + 50% RDF 'N' and 'P' + 100% RDF 'K'	39.83	35.67	37.75	47.40	38.84	43.12	49.23	48.26	48.75	50.33	50.33	50.33	16.42	16.76	16.59
T ₁₄	Azo+ PSB + FYM + 50% RDF	39.63	33.70	36.67	46.70	37.12	41.91	50.06	41.63	45.85	50.33	50.33	50.33	17.11	17.38	17.25
T ₁₅	Azo + PSB + VC + 50% RDF	37.40	33.30	35.35	46.00	36.52	41.26	49.33	40.66	45.00	50.00	50.00	50.00	18.24	18.41	18.33
T ₁₆	Azo + PSB + PM + 50% RDF	39.96	34.10	37.03	46.99	38.73	42.86	49.66	49.66	49.67	51.00	51.00	51.00	17.10	17.18	17.15
	SE (m) ±	1.10	0.53	0.82	0.51	0.45	0.48	0.49	0.64	0.57	0.63	0.70	0.67	0.53	0.28	0.41
	CD at 5%	3.21	1.56	2.39	1.48	1.33	1.40	1.42	1.86	1.65	1.83	2.05	1.95	1.54	0.83	1.19

Conclusion

It is concluded that based on the findings of the experiment, that African Marigold Cv. Bidhan Marigold-2 responded well in terms of plant growth and flowering characters with the application of Azospirillum @ 250 ml/ha + PSB @ 250/ha ml + Vermicompost @ 50 q/ha + 50% NPK (Recommend Dose of Fertilizers). It can be recommended that to obtain higher production above treatment combinations are beneficial for the growers of Eastern Uttar Pradesh and the variety Bidhan Marigold-2 is suitable for commercial cultivation in Eastern Uttar Pradesh for higher yield and better-quality flowers in summer season.

Acknowledgement

It is indeed an immense pleasure for me to express my most sincere and heartfelt gratitude to my guide Dr Ashok Kumar, Associate Professor cum Head, Department of Floriculture and Landscape, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, (U.P.) for her untiring guidance, positive suggestion and self-dedication enable me to complete this study, without which the very existence of this research work would have been impossible.

References

1. Bhat DJ, Sheetal Dogra, Pandey RK, Sharma JP, Shivani Jamwal. Influence of integrated nutrient management on growth, flowering and yield of African marigold cv. Pusa Narangi. *Environment and Ecology* 2010;28(1A):466-468.
2. Chaupoo AS, Kumar S. Integrated Nutrient Management in Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gaiinda. *International Journal of Current Microbiology and Applied Sciences* 2020;9(5):2927-2939.
3. Hashemabadi D, Zaredost F, Ziyabari MB, Zarchini M. Influence of phosphate biofertilizers on quantity and quality features of marigold (*Tagetes erecta* L.). *Australian Journal of Crop Science* 2012;6(3):1101-1109.
4. Kumari A, Sharma BP, Gupta YC, Sharma U, Sharma S. Effect of Biofertilizers Applications on Growth and Flowering of African marigold cv. 'Pusa Narangi Gaiinda' during Different Season of the Year under Mid-Hills Conditions of Himachal Pradesh. *International Journal of Current Microbiology Applied Science* 2019;8(9):234-240.
5. Luthra KL, Saha SK, Awaski PK. Role of rock phosphate in present-day Agriculture. *Indian Journal of Agriculture Chemistry* 1983;15:13-27.
6. Pushkar NC, Rathore SVS, Upadhyay DK. Response of chemical and bio-fertilizer on growth and yield of African marigold (*Tagetes erecta* L) cv. Pusa Narangi Gaiinda. *Asian Journal of Horticulture* 2008;3(1):130-132.
7. Rolaniya MK, Khandelwal SK, Koodi S, Sepat SR, Choudhary A. Effect of NPK bio-fertilizers and plant spacing on growth and yield of African marigold (*Tagetes erecta* L.). *Chemical Science Review and letters* 2017;6:54-58.
8. Rydberg PA. *Tagetes*, North Am. *Flora* 1915;34:148159.
9. Shaikh AJ, Yadlod SS, Kadari IA. Effect of liquid bioinoculants and fertilizer levels on growth and yield of African marigold (*Tagetes erecta* L.) cv. Calcutta. *International Journal of Chemical Studies* 2018;6(6):1968-1970.
10. Sunitha HM, Hunje R, Vyakaranahal BS, Bablad HB. Effect of plant spacing and integrated nutrient management on yield and quality of seed and vegetative growth parameters in African marigold (*Tagetes erecta* L.). *Journal of Ornamental Horticulture* 2007;10(4):245-249.
11. Tisdale SL, Nelson WL, Beaton JD, Halvin JL. *Soil fertility and fertilizer* (Sed.). Prentice-Hall of India Private Ltd. New Delhi 1995.
12. Yadav KS, Pal AK, Yadav D, Mauriya SK. Effect of different bio-fertilizers on growth and flowering of marigold. *Journal of Pharmacognosy and Phytochemistry* 2018;7:1548-1550.
13. Fisher RD, Yates F. *Statistical table for biological and medical research* Oliver and Boyd. Edbery (London): 3rd edition 1949.
14. Kumar D, Singh BP, Singh Nand V. Effect of integrated nutrient management on growth, flowering behaviour and yield of African marigold (*Tagetes erecta* L.) cv. African Giant Double Orange. *J Hortl. Sci.* 2009;4(2):134-137.
15. Kumar A, Kumar A. Effect of bio-fertilizers and nutrients on growth and flower yield of summer season African Marigold (*Tagetes erecta* L.). *Plant Archives* 2017;17(2):1090-1092.