The Pharma Innovation Journal 2023; 12(9): 1225-1227

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 1225-1227

www.thepharmajournal.com
Received: 09-06-2023
Accepted: 12-07-2023

Jagriti
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

PS Markam
Department of Floriculture and Landscape Architecture, College of Agriculture and Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

SK Tamrakar
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Deo Shankar
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Jagriti
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Studies on effect of spacing and different levels of NPK on flower quality and yield of French marigold (*Tagetes patula* L.)

Jagriti, PS Markam, SK Tamrakar and Deo Shankar

Abstract
The objective of this study was to establish the best planting spacing and nitrate, phosphorus, and potassium concentrations for the growth of French marigolds in the Rabi season of 2022–2023. With 15 treatment combinations, a Randomized Block Design (RBD, Factorial) was used. These combinations included three planting spacings (S_1: 30 x 30 cm, S_2: 40 x 30 cm, and S_3: 40 x 40 cm) and five NPK application dosages (F_1: 70:30:10 kg ha^{-1}, F_2: 85:45:25 kg ha^{-1}, F3: 115:75:55 kg ha^{-1}, F_4: 130:90:70 kg ha^{-1}, and F5: 100:60:40 kg ha^{-1}). In accordance with the findings, the treatment combination F_4S_3 substantially had the maximum number of primary branches (29.57), secondary branches (45.22), flowers (110.33), and flower yield per plant (0.276 kg). Which was at par with treatment combination F_4S_2 for the number of primary branches, number of flowers and flower yield per plant.

Keywords: French marigold, nutrient management, spacing, flower yield

Introduction
French marigold (*Tagetes patula* L.) is a popular flowering plant known for its vibrant colours, unique aroma, and remarkable ornamental value. It is extensively cultivated in gardens, parks and floral arrangements due to its captivating beauty and ability to attract pollinators. The quality and yield of French marigold flowers are influenced by various factors, including spacing and nutrient levels.

Marigold has a wide range of uses and is often referred to as "Golden harvest flexible". One of its notable benefits is its production of thiopenes, which are toxic to nematodes. As a result, marigold is utilized as a trap crop in tomato, brinjal, and tobacco cultivation to deter nematode infestations. In recent, marigold has gained commercial importance as a source of carotenoid pigment. The petals of marigold are particularly rich in xanthophyll with lutein being the primary pigment extracted from them. The marigold pigment is an important source of pigment for the poultry industry and is used as a feed supplement to improve the colour of broiler skin and the yolks of eggs. Apart from the poultry industry, marigold dye is also used in textiles, pharmaceutical industries, food supplements, cosmetics etc. as it offers several advantages over synthetic dyes from a natural point of view, including safety and being eco-friendly.

Material and Methods
An experiment was conducted at the Instructional Farm, College of Agriculture and Research Station, singarbhat Kanker, affiliated with Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the Rabi season 2022-23. The objective was to standardize planting distances and the amounts of nitrogen (N), phosphorus (P), and potassium (K) used in the cultivation of French marigolds. With 15 treatment combinations, the trial used a Randomized Block Design (RBD, Factorial). These combinations included three planting spacings (S_1: 30 x 30 cm, S_2: 40 x 30 cm, and S_3: 40 x 40 cm) and five NPK treatment dosages (F_1: 70:30:10 kg ha^{-1}, F_2: 85:45:25 kg ha^{-1}, F_3: 115:75:55 kg ha^{-1}, F_4: 130:90:70 kg ha^{-1}, and F_5: 100:60:40 kg ha^{-1}).

Marigold seeds sown on raised beds (150 x 100 x 10 cm) in line sowing with 4-5 cm spacing and covered with FYM and straw. Irrigation done every two days intervals and seed germination observed in 4-5 days after sowing. Seedlings hardened by reducing of watering before lifting. Seedlings were transplanted 27 days after sowing and light irrigation done just after transplanting. Plant height (in cm), the number of leaves, plant spread (in cm), and the number of primary and secondary branches per plant were all observed and recorded.

The floral characteristics of flower number, flower diameter (in cm), and flower production per plant were noted. The analysis of variance was used to examine the experimental data in accordance with the factorial, RBD design. (Steel and Torrie, 1980) [10].

Result and Discussion

Growth Parameter

Number of primary branches plant^{-1}

The effect of different planting spacing and nutrient doses on the number of primary branches in French marigold was observed significantly difference between treatments. The treatment with NPK at 130:90:70 kg ha^{-1} exhibited the highest number of primary branches (26.76), while the treatment with NPK at 70:30:10 kg ha^{-1} had the lowest number of primary branches (14.95). Wider spacing (40 x 40 cm) showed the highest number of primary branches (20.73), followed by 40 x 30 cm spacing. The interaction of wider spacing (40 x 40 cm) and NPK at 130:90:70 kg ha^{-1} (F_4S_3) resulted in the highest number of primary branches (29.57), while treatment combination F_1S_1 (70:30:10 kg NPK ha^{-1} with 30 x 30 cm) had the lowest number of primary branches (14.02).

Number of secondary branches plant^{-1}

The number of secondary branches was significantly influenced by different NPK doses and spacings. The highest number of secondary branches (40.47) was observed with an application of NPK at 130:90:70 kg ha^{-1}, while the lowest number of secondary branches (27.87) was recorded with NPK at 70:30:10 kg ha^{-1}. Among the different spacings 40 x 40 cm resulted in the highest number of secondary branches (34.79). Conversely, a spacing of 30 x 30 cm had the lowest number of secondary branches (31.42). The treatment with wider spacing (40 x 40 cm) and an application of NPK at 130:90:70 kg ha^{-1} (F_4S_3) exhibited the highest number of secondary branches (45.22). Whereas, the treatment combination F_4S_2 was observed second highest number of secondary branches (45.22) per plant. The treatment combination F_1S_1 (NPK at 70:30:10 kg ha^{-1} and spacing at 30 x 30 cm) displayed the lowest number of secondary branches (27.34).

Flowering and Yield Parameters

Number of flowers plant^{-1}

The number of flowers per plant was significantly influenced by NPK doses and spacings. The treatment F_4 (NPK at 130:90:70 kg ha^{-1}) resulted highest number of flowers (108.33), while the treatment F_1 (NPK at 70:30:10 kg ha^{-1}) had lowest number of flowers (85.67). Plants with spacing of 40 x 40 cm had the maximum number of flowers per plant (99.13), while 30 x 30 cm had the lowest number of flowers (94.40). The combination of wider spacing (40 x 40 cm) and NPK at 130:90:70 kg ha^{-1} (F_4S_3) had the highest number of flowers per plant (110.33). The second highest number of flowers was found in the treatment combination F_4S_2 (NPK at 130:90:70 kg ha^{-1} and spacing at 40 x 30 cm). The treatment combination F_1S_1 (70:30:10 kg ha^{-1}and spacing at 30 x 30 cm) was recorded the lowest number of flowers (84.00).

Average weight of 20 flowers (gm)

The Average weight of flowers was significantly affected by different NPK doses and spacings. The highest average weight of flowers (53.65 gm) was obtained with an application of NPK 130:90:70 kg ha^{-1}(F_4), followed by the treatment with NPK at 115:75:55 kg ha^{-1}(F_3). The lowest average weight (38.66 gm) was observed with NPK at 70:30:10 kg ha^{-1}(F_1). Planting space was also found a significant impact, with a spacing of 40 x 40 cm (S_3) resulted highest average weight of flowers (47.74 gm), while a spacing of 30 x 30 cm (S_1) led to the lowest flower weight (45.90 gm). The interaction between NPK doses at 130:90:70 kg ha^{-1} and planting space (40 x 40) cm showed the maximum average weight of flowers (54.27 gm), which was at par with the treatment combination of NPK at 130:90:70 kg ha^{-1} and a spacing of 40 x 30 cm (F_4S_2). Conversely, the treatment with NPK at 70:30:10 kg ha^{-1} and a spacing of 30 x 30 cm (F_1S_1) was found lowest average weight of flowers (41.18 gm).

Flower yield (q. ha^{-1})

The data presented in the table 1 showed the significant effects of different Spacings and dose of nutrient on the Flower yield q. ha^{-1}.

The application of NPK at 130:90:70 kg ha^{-1} (F_4) produced the highest flower production (169.21 q. ha^{-1}), which was followed by the treatment with NPK at 115:75:55 kg ha^{-1} (F_3). With NPK at 70:30:10 kg ha^{-1} (F_1), a yield of (132.78) q. ha^{-1} was reported to be lower. The size of the planting area had a significant effect on flower production as well. A spacing of 40 x 40 cm produced the highest flower yield (154.43 q. ha^{-1}), while a spacing of 30 x 30 cm produced the lowest flower yield (147.87 q. ha^{-1}). The interaction between NPK doses at 130:90:70 kg ha^{-1} and planting space 40 x 40 cm the highest flower yield (174.91) q. ha^{-1}, which was statistically at par with the treatment combination of NPK at 130:90:70 kg ha^{-1} and a spacing of 40 x 30 cm (F_4S_2). Conversely, the treatment with NPK at 70:30:10 kg ha^{-1} and a spacing of 30 x 30 cm (F_1S_1) was found lowest flower yield (130.2) q. ha^{-1}.

Table 1: Effect of different spacing and doses of nutrient on French marigold

Treatment		No. of primary branches/plant	No. of secondary branches/plant	Number of flowers plant^{-1}	Avg. Fresh weight of 20 flowers (gm)	Flower yield (q. ha^{-1})
Different dose of nutrient						
F_1	(70:30:10)	14.95	27.87	85.67	38.66	132.78
F_2	(85:45:25)	17.23	31.62	94.22	44.23	146.04
F_3	(115:75:55)	19.67	38.03	101.11	49.76	156.72
F_4	(130:90:70)	26.76	40.47	108.33	53.65	169.21
F_5	(100:60:40)	19.34	39.43	97.67	47.04	151.38
Sem±		0.20	0.33	0.35	0.63	2.03
CD at 5%		0.59	0.96	1.01	1.82	5.88
Spacing						
S_1	(30 X 30 cm)	19.03	31.42	95.40	45.90	147.87
S_2	(40 X 30 cm)	20.35	33.98	97.67	46.33	151.38
S_3	(40 X 40 cm)	20.73	34.79	99.13	47.74	154.43

Sem±	0.16	0.26	0.27	0.49	1.57
CD at 5%	0.45	0.74	0.78	1.41	4.56

Table 2: Interaction Effect of different dose of nutrient and spacing on French marigold

Treatments	No. of primary branches/plant	No. of secondary branches/plant	Number of flowers plant^{-1}	Avg. Fresh weight of 20 flowers (gm)	Flower yield (q. ha^{-1})
F_1S_1	14.02	27.34	84.00	41.18	130.20
F_1S_2	15.28	27.76	86.00	43.17	133.30
F_1S_3	15.56	28.52	87.00	48.35	134.85
F_2S_1	16.42	30.63	91.00	37.98	141.05
F_2S_2	16.96	31.39	94.67	40.23	146.73
F_2S_3	18.32	32.86	97.00	37.76	150.35
F_3S_1	21.27	35.72	100.33	50.94	155.52
F_3S_2	23.36	36.93	102.00	47.94	158.10
F_3S_3	24.58	37.54	101.00	50.41	156.55
F_4S_1	25.12	39.44	105.67	52.10	163.78
F_4S_2	26.58	40.22	109.00	53.10	168.95
F_4S_3	29.57	45.22	110.33	54.27	174.91
F_5S_1	17.31	38.64	96.00	45.83	148.80
F_5S_2	19.58	38.14	96.67	47.36	149.83
F_5S_3	21.14	38.04	100.33	47.93	155.52
Sem±	0.35	0.57	0.60	0.76	3.52
CD at 5%	1.01	1.66	1.74	2.03	10.19

Discussion

The combination of wider spacing and high dose of nutrients improved uptake of soil moisture and nutrients during the growth period has resulted in positive outcomes, such as higher flower yield per plant, and per hectare area. Wider spacing (40 × 40 cm) resulted in more primary and secondary branches due to lowest population and ample resources. Similar findings were reported by Mahananda *et al.* (2015) [6], Aashutosh *et al.*, (2019) [1], Kumar *et al.*, (2014) [5], Panday, and Rao (2014) [8], and Kour *et al.* (2012) [4] in chrysanthemum, China aster, and marigold. Wider spacing (40 × 40 cm) resulted in increased flower number, fresh weight and flower yield per unit area due to proper utilization and lower competition. Potassium-treated plants had a higher number of flower and increased dry matter allocation to floral organs. These effects are supported by various studies on different plant species. Similar result reported by Patel *et al.*, (2004) [9], Joshi *et al.*, (2013) [3], Mali *et al.*, (2016) [7], and Chopde *et al.*, (2015) [2].

Conclusion

Based on the latest research findings, it has been determined that for the commercial cultivation of French marigold, economic benefits can be attained by implementing specific treatment combinations. Noticeably, the research indicates that the most advantageous spacing for optimal growth and maximum flower yield in French marigold was found 40 x 40 cm. Furthermore, the application of NPK at the rate of 130:90:70 kg ha^{-1} has been identified as crucial in achieving the desired growth outcomes and obtaining the highest flower yield. Therefore, it can be concluded that incorporating a spacing of 40 x 40 cm and utilizing NPK at 130:90:70 kg ha^{-1} can be deemed as the most beneficial approach for the successful and profitable commercial cultivation of French marigold.

Reference

1. Aashutosh MK, Malik S, Singh MK, Singh SP, Chaudhary V, Sharma VR. Optimization of spacing, doses of vermi-compost and foliar application of salicylic acid on growth, flowering and soil health of chrysanthemum (*Dendranthema grandiflora*, Tzvelev.) cv. "Guldasta". Int. J of Agric., Environ and Biotech. 2019;12(3):213-224.
2. Chopde N, Gore KS, Kuchanwar O, Bhande MH. Response of annual chrysanthemum genotypes to different levels of nitrogen. Plant Archives. 2015;15(2):801-804.
3. Joshi AS, Varu DK, Barad AV, Pathk DM. Performance of varieties and chemical fertilizers on growth and flowering in chrysanthemum. Int. J of Agril. Sci. 2013;9(1):182-88.
4. Kour R. Flower production as effected by spacing and pinching in chrysanthemum cv. 'Flirt'. Int. J of Agril. Sci. 2012;5(2):588-589
5. Kumar PK, Padmalatha T, Pratap M. Effect of spacing and pinching on vegetative growth in china aster (*Callistephus chinensis* L. Nees) cv. Kamini. Plant Archives. 2014;14(2):961-66.
6. Mahananda NW, Munikrishnappa PM, Shantappa T. Effect of different levels of spacing and growth regulators on growth, flowering, flower yield and quality attributes in annual chrysanthemum (*Chrysanthemum coronarium* L.) Trends in Biosciences. 2015;8(23):6634-6639
7. Mali GL, Moond SK, Choudhary A, Bola PK, Chaudhary P. Effect of planting geometry and nitrogen on growth, flowering and yield of chrysanthemum (*Chrysanthemum coronarium* L.). Hort Flora Research Spectrum. 2016;5(1):48-52.
8. Pandey Neeraj, Rao VK. Influence of planting geometry on performance of China aster genotypes under mid hill conditions of Uttarakhand. J of Hill Agri. 2014;5(2):139-143.
9. Patel AP. Effect of nitrogen through urea and castor cake on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ram.) cv. IIHR-6. M.Sc. (Agri.) thesis, Junagadh Agricultural University, Junagadh; c2004.
10. Steel RGD, Torrie JH. Principle and procedures of Statistics, second edition. McGraw Hill Book Co. New York; c1980. p. 336-354.