Original Research Article

Standardization of spacing and nutrition for growth, yield and quality ofFrench marigold (*Tagetes patula* L.)

ABSTRACT

This study was carried out to investigate the standardization of spacing and fertilizer on growth and quality of French Marigold (*Tagetes patula* L.). The treatments consisted of three fertilizer levels (F1:225:60:60 NPK kg per ha, F2: 168.75:45:45 kg NPK kg per ha, F3:112.5:30:30 NPK kg per ha), three spacing levels (S1: 30 cm x 30 cm, S2: 45 cm x 30 cm and S2: 45 cm x 45 cm) tested in factorial randomized block design with three replications. The vegetative parameter viz., plant height increased with decrease in spacing level and increase in nutrition. The interaction of S1F1 (30 x 30 cm: 225:60:60 NPK kg/ ha) recorded higher plant height. Plant spread, number of branches, stem girth, number of leaves. Flower production was significantly influenced by spacing at 45 x 30 cm, and nutrition at 225:60:60 NPK kg/ ha. The treatment combination of S1F6 (45 x 30 cm: 250:75:150 kg/ ha) produced more flower yield per ha (18.20 t/ha). It is on par with S1F5 i.e 17.64 t/ha. Increasing levels of spacing and nutrition increased the duration of flowering, flower diameter, flower weight, shelf life of flower on plant and seed yield significantly. Duration of flowering, flower diameter, flower weight, shelf life of flower on plant yield proved superior with 45 x 45 cm spacing and nutrition at 225:60:60 NPK kg/ ha

Keywords: French marigold, spacing, NPK, yield, quality;

1. INTRODUCTION

The marigold is a year-round commercial flower cultivated primarily for loose flower production, contributing significantly to its prominence in the domestic flower market. The diverse agroclimatic zones offer numerous natural advantages, including ample sunlight, optimal temperatures, and soil characteristics conducive to healthy plant growth. These zones are particularly promising for the cultivation of various marigold genotypes due to their unique climates and rich biodiversity. Marigold oil, known for its distinct aroma, serves as an effective repellent against flies(Priyambada*et al*., 2015). Additionally, marigolds are recognized for their insect-repellent properties, reducing insect and nematode activity when grown in fields, which subsequently benefits subsequent crops. The cultivation of marigolds also provides economic opportunities, thereby partially alleviating unemployment issues in both public and private sectors.

The genus Tagetes comprises 33 species, but only two are cultivated commercially: *Tagetes erecta* L., known as the African marigold, and *Tagetes patula* L., known as the French marigold. Due to their diverse blossom heights and colors, these species are utilized in landscape architecture and for loose flower supply (Serrato-Cruz *et al.*, 2000).

French marigolds are particularly valuable in landscaping for their vibrant colors, ranging from deep orange and red to bright yellow, and their natural insect-repellent properties, which enhance the health and vitality of neighboring plants. Their compact size and abundant blooming make them ideal for creating striking borders, filling gaps in garden beds, and adding pops of color to container gardens(Choudhary *et al*, 2014). In addition to their aesthetic appeal, French marigolds repel harmful insects and attract beneficial pollinators, contributing to an ecologically balanced environment.

Nitrogen (N), phosphorus (P), and potassium (K) fertilizers are essential for optimal crop production, each serving distinct functions that collectively enhance plant growth and yield. Nitrogen is crucial for photosynthesis and protein synthesis, promoting vigorous vegetative growth and vibrant green foliage. Phosphorus is vital for energy transfer, root development, and the formation of flowers and seeds, ensuring robust early plant development and successful reproduction. Potassium regulates water and nutrient movement, strengthens stems, and enhances resistance to diseases and environmental stress, contributing to overall plant health and quality(Bansal *et al.*, 1995). Together, these macronutrients support balanced nutrition, leading to higher crop yields and improved quality, making them fundamental components of agricultural productivity.Therefore, enhancing soil fertility through the judicious application of NPK fertilizers can substantially increase flower yield. Spacing also plays a critical role in achieving healthy vegetative growth and producing high-quality flowers. Wider spacing enhances the photosynthetic area and reduces nutrient competition, whereas closer spacing increases flower yield but can negatively affect vegetative growth. The interaction between fertilizers and plant spacing can significantly influence the growth and flowering behavior of marigold plants. Given these considerations, the present research investigates the effects of fertilizers and spacing on the flowering and yield of French marigold.

2. MATERIALS AND METHODS

The experiment was laid out in the field during 2021-2022 by following recommended package of practices for spacing and fertilization (Anonymous, 2018).

List 1 :Nutrients used in the study

Type of application	Source of nutrients	Nutrient content
Soil application	Urea	46% N
	SSP	16% P_2O_5
	MOP	60% K_2O

Crop : French marigold

Genotype :UHSFm 10

Design: Factorial RCBD

Treatments: 09

Replications: 03

Plot size: 3 x 4 m

Number of factors: Two

List 2 :Treatment details

The details of treatment are given below:

Factor 1: Spacing	Factor 2: Nutrient levels
S1: 30 x 30 cm	F1: 100% RDF(225:60:60 NPKkg/ha)
S2: 45 x 30 cm	F2: 75% RDF(168.75:45:45 kg NPK ha^{-1})
S3: 45 x 45 cm	F3: 50% RDF (112.5:30:30 kg NPK ha^{-1})

The treatment combinations are as follows:

T_1: S1 × F1 (30 x 30 cm × 100% RDF 225:60:60 NPK kg/ha)

T_2: S1 × F2(30 x 30 cm × 75% RDF NPK kg/ha)

T_3: S1 × F3 (30 x 30 cm × 50% RDF NPK kg/ha)

T_4: S2 × F1 (45 x 30 cm × 100% RDF 225:60:60 NPK kg/ha)

T_5: S2× F2 (45 x 30 cm × 75% RDF NPK kg/ha)

T_6: S2× F3 (45 x 30 cm × 50% RDF 187.5:100:75 NPK kg/ha)

T_7: S3 × F1 (45 x 45 cm × 100% RDF 225:60:60 NPK kg/ha)

T_8: S3× F2 (45 x 45 cm × 75% RDF NPK kg/ha)

T_9: S3 × F3 (45 x 45cm × 50% RDF 187.5:100:75 NPK kg/ha)

Seeds are sown in pro- trays one month after sowing the seedlings are transplanted to main field with three spacing levels (S1: 30 cm x 30 cm, S2: 45 cm x 30 cm and S3: 45 cm x 45 cm) as per the treatment. The experimental plots were incorporated with well decomposed FYM, Half dose of N and full dose of P and K was applied as a basal dose and remaining half dose applied at 30 days after transplanting. All cultural operations were carried out uniformly.Nitrogen content in leaf was estimated by Modified Kjeldahls procedure, phosphors by calorimetric method and potash with the help of flame photometer as described by Jackson (1973). Available nitrogen in the soil was determined by alkaline permanganate method as outlined by Subbiah and Asija (1956), available phosphorus was estimated by colorimetric method as outlined by Olsen *et al.* (1954) and available potassium was extracted with neutral normal ammonium acetate and the quantity was determined by using flame photometer as suggested by Stanford and English (1963)expressed in kg per hectare. The data was recorded on different growth and yield parameters from five tagged plants and average was statistically analyzed.

3.6.1 Growth parameters

3.6.1.1 Plant height (cm)

Plant height was measured from the base of the main stem to the tip of the main stem from all the five tagged plants in each plot with meter scale. The average plant height was then computed in centimeters.

3.6.1.2 Plant spread (cm)

Plant spread was assessed from East-West and North-South directions by using a measuring scale and the mean plant spread was worked out for both East-West and North-South direction of plant spread**.**

3.6.1.3 Number of primary branches

Every branch which emerged from the main stem of the plant were counted manually and recorded. The observations were noted down from all the five tagged plants and then the mean number of primary branches were counted.

3.6.1.4 Number of secondary branches

The branches which were developed from primary branches were manually counted and then the average number of secondary branches were calculated by observing all five tagged plants in the plot.

3.6.2 Flowering parameters

3.6.2.1 Days to first flowering

Days taken for the first flower opening was recorded from each plot by counting the days from the date of transplanting to the opening of first flower.

3.6.2.2 Days to 50 per cent flowering

The number of days taken for 50 per cent flowering was recorded from each plot by counting the days from the date of transplanting till the 50 per cent of plants flowered.

3.6.2.3 Duration of flowering (days)

Number of days taken from the first flowering to the last flowering in a plant was recorded as the total duration of flowering in each plot.

3.6.3 Yield parameters

3.6.3.1 Number of flowers per plant

The number of flowers per plant was counted from the five tagged plants from each replication till the final harvest and average was calculated.

3.6.3.2 Flower yield (g/plant)

After recording the number of flowers per plant, all the flowers were weighed separately at every harvest from each plant till the final harvest and the average flower yield per plant was calculated and expressed in grams per plant.

3.6.3.3 Flower yield (kg/plot)

Flower yield per plot was worked out by totaling the weight of flowers per plot, recorded and expressed in kilograms.

3.6.4 Quality characters

3.6.4.1 Flower diameter (mm)

Diameter of the flower was measured at the point of maximum breadth at full bloom stage, this was measured by vernier caliper and average diameter was expressed in milimeter.

3.6.4.2 Shelf life (days)

Fully opened flowers were harvested from each plot and kept in paper plates in laboratory condition. Number of days was counted until the flowers lost their marketable quality.

3.6.4.3 Individual flower weight (g)

After recording the number of flowers per plant, the weight of individual flower was recorded in grams from the tagged plants and averages were worked out for individual flower weight.

Statistical analysis:

The recorded data were statistically analyzed (ANOVA analysis) using the software OPSTAT, (developed at O.P. Sheoran, Computer Section, CCS HAU, Hisar, India). Sources of variation were fertilizer treatments. Mean comparisons were performed using LSD test to determine whether the difference between the variables were significant at $P < 0.05$.

3. RESULTS AND DISCUSSION

Growth parameters

The treatment differences due to different levels spacing and fertilizer application were significant for plant height, plant spread andnumber of branches (Table 1).

At 90 DAT except plant height, plant spread at both direction E-W andN-S was recorded maximum in (S3) 45 x 45 cm spacing (32.95 cm and 29.68 cm) which was significantly higher than S2 (28.20 cm and 26.44 cm)and S1 (18.13 cm and18.02 cm). Similarly, number of primary and secondary branches was recorded maximum in (S3) 45 x 45 cm spacing (14.03 and 29.79) which was significantly higher than S2 (12.37 and 23.87). Plant height was recorded maximum in S1(40.71)(Table 1).

In case Fertilizer doses,at 90 DAT plant height (39.10cm), plant spread at both direction E-W (32.03 cm) and N-S (30.01) and number of primary and secondary branches (13.67 and 29.07), was recorded maximum in F1 and it was minimum inF3.

In case of interaction the wider spacing with higher fertilizer dose (S3F1) shows plant spread at both direction E-W (34.93 cm) and N-S (31.74 cm) and number of primary branches (14.80) and secondary branches (31.10)

Among the treatment combinations, maximum plant height (18.52, 32.85 and 43.82 cm) was recorded in S1F1 (30 x 30 cm + 225:60:60 N, P2O5, K2O kg ha-1) at 30, 60 and 90 DAT, respectively. The minimum plant height (13.60, 20.19 and 30.29 cm) was noticed in S3F3 (45x 45 cm + 50% RDF) at all stages respectively.

Increase in plant height at closer spacing might be due to heavy competition between plants for light resulted in elongation of main stem and also might be due to fact that the plants tend to grow vertically when they are crowded owing to shadowing effect of the plants on one another. Nain *et al*, 2017 also obtained maximum plant height at a closer spacing of 30x30 cm in marigold.The results are in conformity with the findings of Chauhan *et al*. (2014), Meena *et al.* (2015) in African marigold and Sonara*et al*. (2023) in marigold.

Whereas, with regard to branches per plant, spread of plant, the treatment combination S3F1 (45 × 45 cm, 225:60:60 kg NPK/ha) whichwas on par (26.10 and 29.85 cm) with S3F2 (45 × 30 cm, 168.75:45:45 kg NPK/ha) andit was minimum (21.31 and 24.95 cm) in S1F3 (30 × 30 cm, 112.5:30:30 kg NPK/ha)combination(Table 2). This suggests that a closer spacing of 30 cm x 30 cm combined with enhanced nutrition produced the tallest French marigold plants. Conversely, a wider spacing of 45 cm x 45 cm, also with higher nutrition, positively impacted all other growth parameters except for plant height.

Yield parameters

Table 3 presents the data on flower yield, highlighting the effects of spacing, fertilizer, and their interactions. Spacing had significant influence on number of flowers per plant. Maximum (129.63) number of flowers per plant was recorded in 45 × 45 cm spacing (S3), followed by S2 (45 × 30 cm) (118.72) and it was recorded minimum (109.87) in S1 (30 × 30 cm). Maximum number of flowers per plant (142.08) was recorded in F1 (225:60:60 kg NPK/ha), which was followed (116.43) by F2 (168.75:45:45 kg NPK/ha) and minimum (99.70) number of flowers per plant was observed in F3 (112.5:30:30 kg NPK/ha). However, in interactions, maximum (164.10) number of flowers per plant was recorded in treatment combination of S3F1 (45 × 45 cm, 225:60:60 kg NPK/ha) and it was recorded minimum (93.60) in S1F3 (30 × 30 cm, 112.5:30:30 kg NPK/ha) treatment combination.

Similarly, maximum flower yield per plant (300.70 g/plant), maximum flower yield per plot (24.68 kg) was recorded in S3 (45 × 45 cm) which was on par with S2 (45 × 30 cm) (289.90 g/plant) and whereas S1 (30 × 30 cm) recorded a minimum flower yield per plant (273.65 g).

Higher (316.03 g/plant) (18.39 kg/plot) flower yield per plant and per plot, was recorded in F1 (225:60:60 kg NPK/ha), followed by (302.63 g/plant) in F3 (168.75:45:45 kg NPK/ha) and it was lower (245.59 g/plant) in F3 (112.5:30:30 kg NPK/ha). The treatment combination of S3F1 (45 × 45 cm, 225:60:60 kg NPK/ha) recorded maximum flower yield (323.84 g/plant) and maximum flower yield per plot (27.05 kg/plot), followed by S3F2 (45 × 45 cm, 168.75:45:45 kg NPK/ha) (302.63 g/plant) (25.81 kg/plot) combination and it was lowest in S1F3 (30 × 30 cm, 112.5:30:30 kg NPK/ha) treatment combination.

Flower production in French marigold was significantly influenced by the increasing spacing levels (Fig. 1). Number of flowers increased gradually as the levels of spacing increased from 30 × 30 cm to 45 × 45 cm,similar trend was recorded for flower yield (g/plant). Maximum yield per plant at wider spacing might be due to fact that, in wider spacing the number of branches per plant was more which in turn lead to maximum number of flowers per plant and flower yield per plant.Divyashree *et al.* (2016) also obtained higher yield and maximum number of flowers at wider spacing (60 × 60 cm) in gaillardia. Similar results were also reported by Hugar (1997) in gaillardia, Sharma *et al.* (2009) in marigold, Dorajeerao*et al.* (2012b) in annual chrysanthemum, Kour *et al.* (2012) in marigold and Duggani*et al.* (2023) in gomphrena.

Quality parameters

Individual flowers weight was recorded maximum (1.06g) in 45 × 45 cm (S3) followed by S2 (45 × 30 cm) (1.00g) while, S1 (30 × 30 cm) recorded a minimum individual flower weight (0.94g) (Table 4). Higher (1.09 g) individual flower weight was recorded in F1 (225:60:60 kg NPK/ha), followed by (0.99 g) in F2 (168.75:45:45 kg NPK/ha) and it was lower (0.91 g) in F3 (112.5:30:35 kg NPK/ha).

Among the different spacing, 45 × 45 cm (S3) produced significantly flowers with a higher diameter (4.35 cm) followed by S2 (45 × 30 cm) (4.09 cm) while, flower diameter was less (3.86 cm) in S1 (30 × 30 cm). There was a significant influence of varied NPK levels on flower diameter. It was maximum (4.27 cm) in F1 (225:60:60 kg NPK/ha), followed by 4.13 cm in F2 (168.75:45:45 kg NPK/ha) and it was minimum (3.90 cm) in F1 (112.5:30:30 kg NPK/ha). It was maximum (4.52 cm) in the treatment combination of S3F1 (45 × 45 cm, 225:60:60 kg NPK/ha). However, it was statistically on par (4.34 cm) with the treatment combination of S3F2 (45 × 45 cm, 168.75:45:45 kg NPK/ha) and it was minimum (3.61 cm) in S1F3 (30 × 30 cm, 112.5:30:30 NPK/ha) treatment combination.

Maximum shelf life of the flowers (3.58 days) was recorded in S3 (45 × 45 cm) spacing followed by S2 - 45 × 30 cm (3.33 days) and it was minimum (2.63 days) in S1 (30 × 30 cm). Similarly, maximum shelf life of flowers (3.53 days) was recorded at higher level of NPK F1 (225:60:60 kg NPK/ha), followed by F2 - 168.75:45:74 kg NPK per hectare (3.25 days) and minimum (2.77 days) shelf life was recorded in F3 (112.5:30:30 kg NPK/ha). The treatment combination S3F4 (45 × 45 cm, 225:60:60 kg NPK/ha) recorded maximum (3.95 days) shelf life of the flowers, followed by S3F2 (45 × 45 cm, 187.5:100:75 kg NPK/ha) treatment combination (3.75 days), and it was less (2.77 days) in S1F3 (30 × 30 cm, 112.5:30:30 kg NPK/ha) combination.

Spacing plays a major role in production of quality flowers by providing good aeration as well as light during flowering period. Duggani*et al*. (2023) also reported that all the quality traits recorded highest in wider spacing of 60 cm x 30 cm in gomphrena. It is mainly due to availability more nutrients and less competition between the plant for nutrients resulted in increase in size and weight of flower. NPK application may have accelerated photosynthesis by increasing the source size (number of branches and leaf size), thereby giving more photosynthates to developing flowers, which may have resulted in higher cell division and cell expansion of flower tissues. Similar results were reported previously by Hugar (1997) in gaillardia, Chaudhary *et al.* (2008) in annual chrysanthemum and Munikrishnappa (2011) in China aster.

Available nutrient in soil

The significant difference in nitrogen, phosphorus and potassium content was noticed. The highest available nitrogen, phosphorus and potassium (185.87, 49.87 and 262.82 kg ha^{-1}) of soil was obtained in S3 (45 x 45 cm) respectively. Whereas, lowest available nitrogen, phosphorus and potassium (180.58, 43.97 and 241.97 kg ha-^{1}) was noticed in S1 (30 x 30 cm).

However, the available soil NPK was found maximum (184.41, 47.15 and 255.79kg ha-^{1}) in treatment F_1 (225:60:60 N, P_2O_5, K_2O kg ha^{-1}). The results are in conformity with the findings of Mohanty *et al*. (2000) in tuberose Samantaray*et al*. (1999) in marigold. Among the interaction effect, S3F1 (45 cm × 45 cm: 225:60:60 kg NPK/ha) showed maximum available soil NPK.

There is significant effect of different levels of NPK on nutrients availability in soil was observed in the present study and the maximum available soil NPK was recorded in higher levels of NPK (225:60:60 kg/ha). This might be due to the higher available nitrogen present in the soil and also due to external application of nitrogenous and potassium fertilizers and their preferential absorption. The linear increase in nitrogen, phosphorus and potassium content upto F_1 might be also due to the synergetic effect of phosphorus and potassium. The results are in conformity with the findings of Hugar and Nalawadi (1999) in gaillardia, Karuppaiah and Krishna (2005) in marigold, Airadevi (2012) and Sanas *et al.* (2018) in *Chrysanthemum coronarium*.

Conclusion

From the present investigation, closer spacing 30 × 30 cm and higher NPK (225:60:60 kg NPK/ha) was beneficial to get maximum flower yield per hectare. Whereas, wider spacing 45 × 45 cm with higher NPK was best to get good vegetative growth, superior quality of flowers.

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Table 1. Effect of spacing and varied levels of NPK on plant height (cm) and plant spread (cm) in French marigold

	Plant Height (cm)				Plant Spread E-W (cm)				Plant Spread N-S (cm)			
	90 DAT				90 DAT				90 DAT			
	F_1	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**
S_1	43.82	41.16	37.16	**40.71**	29.42	27.72	25.68	**27.61**	28.63	26.64	24.95	**26.74**
S_2	40.12	38.42	35.50	**38.01**	31.73	30.35	27.70	**29.95**	29.67	27.72	26.61	**28.00**
S_3	33.36	31.67	30.29	**31.77**	34.93	32.82	31.11	**32.95**	31.74	29.58	27.73	**29.68**
Mean	**39.10**	**37.08**	**34.32**		**32.03**	**30.30**	**28.19**		**30.01**	**27.98**	**26.43**	
	S. Em.±		**CD at 5%**		**S. Em.±**		**CD at 5%**		**S. Em.±**		**CD at 5%**	
Spacing (S)	1.05		3.14		0.89		2.69		0.77		2.32	
Fertilizer(F)	1.05		3.14		0.89		2.69		0.77		2.32	
S×F	1.81		5.43		1.55		4.65		1.34		4.02	

DAT-Days after transplanting, NS- Non-significant, F=NPK levels, S=Spacing, SxF = Spacing x NPK levels

F_1-225 :60:60 kg NPK ha^{-1} F_2-168.75:45:45 kg NPK ha^{-1} F_3-112.5:30:30 kg NPK ha^{-1}

S_1^- 30 X 30 cm S_2 –45 X 30 cm S_3 - 45 X 45

Table 2. Effect of spacing and varied levels of NPK on number of branches in French marigold

	Number of primary branches				Number of secondary branches			
	90 DAT				90 DAT			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
S_1	12.50	11.70	**11.20**	**11.80**	26.70	25.30	24.90	**25.64**
S_2	13.70	12.90	12.10	**12.90**	29.30	28.00	26.20	**27.86**
S_3	**14.80**	13.90	13.40	**14.03**	**31.10**	30.06	28.20	**29.79**
Mean	**13.67**	**12.83**	**12.23**		**29.07**	**27.79**	**26.43**	
	S. Em.±		**CD at 5%**		**S. Em.±**		**CD at 5%**	
Spacing (S)	0.36		1.07		0.68		2.05	
Fertilizer(F)	0.36		1.07		0.68		2.05	
S×F	0.62		NS		1.18		3.54	

DAT-Days after transplanting, NS- Non-significant, F=NPK levels, S=Spacing, SxF = Spacing x NPK levels

F_1-225 :60:60 kg NPK ha^{-1} F_2-168.75:45:45 kg NPK ha^{-1} F_3-112.5:30:30 kg NPK ha^{-1}

$S_1$$^{-}$ 30 X 30 cm S_2 –45 X 30 cm S_3 - 45 X 45

Table 3. Effect of spacing and NPK levels on number of flowers/ plant and flower yield per plant (g) in French marigold

Spacing/ Fertilizer	Number of flowers/plant				Yield per plant(g/plant)				Yield per plot(kg/plant)			
	F_1	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**
S_1	123.10	112.90	**93.60**	**109.87**	308.10	281.55	**231.30**	**273.65**	10.78	9.55	**7.87**	**9.40**
S_2	139.50	116.80	100.30	**118.72**	315.99	306.78	246.92	**289.90**	17.35	16.21	13.36	**15.64**
S_3	**164.10**	119.60	105.20	**129.63**	**323.84**	319.56	258.54	**300.70**	**27.05**	25.81	21.18	**24.68**
Mean	**142.08**	**116.43**	**99.70**		**316.03**	**302.63**	**245.59**		**18.39**	**17.19**	**14.14**	

	Number of flowers/plant: S. Em.±	Number of flowers/plant: CD at 5%	Yield per plant: S. Em.±	Yield per plant: CD at 5%	Yield per plot: S. Em.±	Yield per plot: CD at 5%
Spacing (S)	3.51	10.55	6.44	19.35	0.54	1.63
Fertilizer(F)	3.51	10.55	6.44	19.35	0.54	1.63
S×F	6.01	18.06	11.17	33.49	0.93	2.81

DAT-Days after transplanting, NS- Non-significant, F=NPK levels, S=Spacing, SxF = Spacing x NPK levels

F_1-225 :60:60 kg NPK ha^{-1} F_2-168.75:45:45 kg NPK ha^{-1} F_3-112.5:30:30 kg NPK ha^{-1}

S_1- 30 X 30 cm S_2 –45 X 30 cm S_3 - 45 X 45 cm

Table 4. Effect of spacing and NPK levels on quality parameters in French marigold

Spacing/ Fertilizer	Individual flowers weight (g)				Flower diameter(cm)				Shelf life(days)			
	F_1	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**	**F_1**	**F_2**	**F_3**	**Mean**
S_1	1.03	0.93	**0.85**	**0.94**	4.02	3.95	**3.61**	**3.86**	2.85	2.75	**2.30**	**2.63**
S_2	1.09	0.99	0.91	**1.00**	4.27	4.11	3.89	**4.09**	3.80	3.25	2.95	**3.33**
S_3	**1.15**	1.05	0.98	**1.06**	**4.52**	4.34	4.19	**4.35**	**3.95**	3.75	3.05	**3.58**
Mean	**1.09**	**0.99**	**0.91**		**4.27**	**4.13**	**3.90**		**3.53**	**3.25**	**2.77**	
	S. Em.±		**CD at 5%**		**S. Em.±**		**CD at 5%**		**S. Em.±**		**CD at 5%**	
Spacing (S)	0.02		0.08		0.11		0.37		0.08		0.27	
Fertilizer(F)	0.02		0.08		0.11		0.37		0.08		0.27	
S×F	0.04		0.14		0.19		0.58		0.16		0.47	

DAT-Days after transplanting, NS- Non-significant, F=NPK levels, S=Spacing, SxF = Spacing x NPK levels

F_1-225 :60:60 kg NPK ha^{-1} F_2-168.75:45:45 kg NPK ha^{-1} F_3-112.5:30:30 kg NPK ha^{-1}

S_1- 30 X 30 cm S_2 –45 X 30 cm S_3 - 45 X 45 cm