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Original Research Article

Effect of Nitrogen and Spacing on Flowering and Yield of Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda

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A B S T R A C T

A Field experiment was conducted to ascertain the influence of nitrogen and spacing on flowering and yield of Marigold *(Tagetes erecta* L.) cv. Pusa Narangi Gainda during winter season of the years 2017-18 and 2018-19 at the Horticultural Research Farm, Department of Horticulture, C.C.S. University, Campus, Meerut,(U.P.). The experiment was laid out in Factorial Randomized Block Design (F.R.B.D.) with three replications. The results revealed significant response on flowering and yield character. It was observed that among four different nitrogen levels viz; 0, 150, 200 and 250 kg N/ha, pooled results indicated the earliest flowering (59.19 days) was recorded under the treatment N_2 (200kg N/ha) and the maximum improvement in various flower and yield character viz; number of flower per plant (35.38), flower diameter (5.50 cm), weight of flower per plant (251.28 g), weight of single flower (7.03 g), yield of flower(156.64 q/ha) were observed under 250 kg N/ha. Among four different spacing viz; 30x30 cm, 45x30cm, 45x45 cm and 60x45 cm, tried, wider spacing (60x45 cm) produced more day to first flowering (58.68), number of flower per plant (35.91), flower diameter(6.01 cm), weight of single flower(275.57 g), weight of flower per plant (7.54 g).While maximum flower yield/plant (184.06 q/ha) was also recorded at closer spacing i.e. 30x30 cm. Among interactions of nitrogen levels and spacing are concerned, the earliest flowering (57.03) was recorded under the application of 200 kg N/ha and wider spacing 60x45 cm (N_2S_4). The application of 250 kg N/ha and spacing 60x45 cm (N_3S_4) recorded maximum value of flower character viz; number of flowers (39.29), flower diameter(6.54 cm), weight of single flower(8.23 g), weight of flower per plant (323.41 g) and the application of 250 kg N/ha and spacing 30x30 cm (N_3S_1) recorded maximum value of yield characters viz; flower yield/plant (206.14 q/ha).

Keywords

Nitrogen, Spacing, flowering and yield, African marigold

Introduction

Floriculture, we can found the caught the eye of the farmers as an enterprise, which can yield higher returns per unit area. The flowers are the supreme glory of God's creation and are an inseparable part of human life. Flower talk to us in language of sentiment and emotions moreover, they are the part of age ancient tradition and culture of the Indian society. Flowers are mentioned in the social fabric of our country and without flowers every function is incomplete. It play vital role in our life, mainly due to aesthetic, economic and social aspect. Marigold (*Tagetes erecta* L.) is one of the famous flowers belongs to

Asteraceae (compositae) family and cultivated throughout India all around the year. Marigolds are beautiful bright flower that are very attractive to the eyes and are often favored to be love charms. It is native of central and South America, especially Mexico; from Mexico it spread to different parts of the world during early part of the 16th century (Kaplan, 1960).

At present, in India, the total area & production under floral crops is324 thousand hectare and1962.02thousand MT loose flower &822.75thousand MT cut flower, during the year (NHB -2017-18).In India, African marigold flowers are sold in the market as loose flower or after making into garland. Flowers are traditionally used for offering in churches, temple, receptions, farewells, birthday occasion, wedding ceremonies and various public and social events. The interest for Marigold blossoms at the time Dashara, Diwali and Ugadi celebrations is extremely high. Both, leaves and flower have been reported to be medicinally important. Leaf remove is acceptable solution for ear ache. Flower extract is used as blood purifier and cure for bleeding piles. It is also good remedy for eye diseases and ulcers. A few types of *Tagetes* are utilized for basic oil extraction. The basic oil present in various types of *Tagetes* can discover utilization in the fragrance business.

The oil has an articulated smell and goes about as an anti-agent to flies. Marigold is also known as insects repellent and growing in fields it minimizes the insects and nematodes activities and probably benefited the next crop in the field. Today's unemployment problems creating due to increasing public load day by day, thus marigold growing provided more chances for earned money hence aid to solved unemployment problem partially in public and private sectors. Nitrogen applied as fertilizer is the main source used to meet the N requirements of plant growth (Konnerup and Brix 2010). When used properly, at the correct application rates and at the right time, N contributes to optimal growth (Gadagi *et al.,* 2004). Nitrogen is major constituent of protein which occurs in the reproductive and vegetative cells of the every plant. Besides, Nitrogen is present in many other plant compounds which are great physiological importance in metabolism such as chlorophyll, nucleotides, phospholipids, alkaloids, enzymes, hormones and vitamins. Hence, flower yield can be increased to a large extent by improving soil fertility by judicious application of nitrogen. Spacing plays an important role for healthy vegetative growth and in production of good quality flower. A wider spacing increases the photosynthetic area and reduces the competition for nutrients, while the reverse is true for closer spacing. Therefore, wider spacing facilitates good vegetative growth but in turn affects flower yield, while closer spacing increase flower yield, but vegetative growth gets affected. Moreover, the interaction effect of fertilizers nitrogen and spacing may dramatically influence the growth and flowering behavior of marigold plants. Hence considering the above facts the present research work was carried out to effect of nitrogen and spacing on flowering and yield of African marigold *(Tagetes erecta* L.) cv. Pusa Narangi Gainda

Materials and Methods

The Present experiment was conducted during the winter season at the Horticulture Research Farm, Department of Horticulture, C.C.S. University, Campus, Meerut, (U.P.) in 2017-2018 and 2018-2019. The soil of experimental field was sandy loam with neutral in reaction (7.4 pH), low in organic carbon (0.41%), medium in available nitrogen (0.052%), phosphorus (0.0079%)

and potassium (0.0202%). There were 16 treatment combination of four levels of nitrogen i.e. 0 kg/ha (N_0), 150 kg/ha (N_1), 200 kg/ha (N_2) and 250 kg/ha (N_3); four levels of spacing i.e. 30x30 cm (S_1), 45x30 cm (S_2), 45x45 cm (S_3) and 60x45 cm (S_4); and their interactions (N_0S_1), (N_1S_1), (N_2S_1), (N_3S_1), (N_0S_2), (N_1S_2), (N_2S_2), (N_3S_2), (N_0S_3), (N_1S_3), (N_2S_3), (N_3S_3),(N_0S_4),(N_1S_4),(N_2S_4), (N_3S_4) were used for the experimental study. The experiment was laid out in factorial randomized block design with three replications. Four weeks old healthy and uniform seedlings were transplanted in plots having size of 1.80x 1.80 m, at the specified spacing. Nitrogen doses were applied through urea. Respectively, one half-dose of nitrogen was applied at the time of seedlings transplanting and the remaining half dose was applied at 30 and 50 days after transplanting as top dressing.

The observations on different flowering and yield characters; days to first Flowering (days), number of flowers, flower diameter (cm), weight of single flower (g), weight of flower per plant (g), yield of flower (q/ha) were recorded from time to time on randomly selected five competitive plants per plot in each replication. All other cultural practices were followed as per recommendations. The data recorded during the course of investigation were statistically analyzed by using analysis of variance (Panse and Sukhatme, 1967).

Results and Discussion

Effect of nitrogen

The data presented in table 1 also showed that the different nitrogen levels used, The Flowering and yield character were also significantly influenced by the different levels of nitrogen. The plants supplied with nitrogen 200 kg/ha (N_2)was blooming earliest (59.19 DAT), while the maximum number of flower/plant (35.38), flower diameter (5.50 cm), weight of flower per plant (251.28 g), weight of single flower (7.03 g) and yield (156.64 q) were recorded under 250 kg/ha (N_3).A higher dose of nitrogen 250 kg/ha resulted in delayed flowering, which may due to an increase the vegetative phase of marigold. Similar results were also found by Anuradha *et al.*, (1990) and Ravindra *et al.*, (1986) in marigold. Karuppiah and Krishna (2005) reported that application of 400 kg N /ha gave the highest number of flower, single flower weight and flower diameter in marigold. The increased yield as a result of nitrogen application could be explained on the basis with the onset of flowering phase there is subsistence anabolic activities and redistribution of organic and organic nutrient components.

As the plant enters into the reproductive phase the vegetative growth ceases to develop anymore, thus, the nitrogen, which was earlier has been utilized by vegetative part, was translocated towards regenerative organs where it joined with the oxygen being developed during photosynthesis and shaped amino acids. These findings were in accordance with the result of Baboo and Sharma (1997) in chrysanthemum.

Effect of Spacing

A Perusal of data presented in Table 1 revealed that various flowering and yield parameters were significantly influenced by spacing. The earliest flowering (58.68 DAT), Number of flower per plant (35.91), flower diameter (6.01 cm), weight of flower per plant (275.57 g), weight of single flower (7.54 g), were recorded under wider spacing (60x45 cm). The maximum Yield (184.06 q) was recorded in closer spacing (30x30 cm). It may be due to highest number of plant population per unit area with closer spacing.

Table.1 Effect of nitrogen and spacing on flowering and yield of Marigold (*Tagetes erecta L.*) cv. Pusa Narangi Gainda

Treatment	Days to first Flowering (Days)	Number of Flower per plant	Flower Diameter (cm)	Weight of Flower per Plant (g)	Weight of Single flower (g)	Yield of flower (q/ha)
Nitrogen (kg/ha)						
0(N_0)	62.69	27.12	3.85	152.98	5.63	102.02
150 (N_1)	60.49	33.77	5.09	231.54	6.77	143.23
200 (N_2)	59.19	34.56	5.25	240.41	6.87	148.35
250 (N_3)	61.50	35.38	5.50	251.28	7.03	156.64
SE (m) ±	**0.125**	**0.154**	**0.061**	**1.276**	**0.011**	**0.950**
CD at 5%	**0.365**	**0.450**	**0.180**	**3.728**	**0.034**	**2.775**
Spacing (cm)						
30x30 (S_1)	62.49	28.47	3.87	165.65	5.79	184.06
45x30 (S_2)	61.86	32.15	4.70	198.99	6.15	147.58
45x45 (S_3)	60.85	34.30	5.11	236.00	6.80	116.55
60x45 (S_4)	58.68	35.91	6.01	275.57	7.54	102.06
SE (m) ±	**0.125**	**0.154**	**0.061**	**1.276**	**0.011**	**0.950**
CD at 5%	**0.365**	**0.450**	**0.180**	**3.728**	**0.034**	**2.775**

Table.2 Interaction effect of nitrogen and spacing on flowering and yield of Marigold (*Tagetes erecta L.*) cv. Pusa Narangi Gainda

Treatment	Days to first Flowering (Days)	Number of Flower per plant	Flower Diameter (cm)	Weight of Flower per Plant (g)	Weight of Single flower (g)	Yield of flower (q/ha)
Interaction (NxS)						
N_0S_1	63.89	25.39	3.60	142.65	5.58	158.50
N_1S_1	62.16	28.76	3.75	165.26	5.74	183.62
N_2S_1	60.59	29.26	3.90	169.16	5.78	187.96
N_3S_1	63.33	30.46	4.24	185.53	6.09	206.14
N_0S_2	63.39	26.89	3.83	150.62	5.60	112.28
N_1S_2	61.46	33.19	4.66	205.91	6.20	152.53
N_2S_2	60.16	33.83	4.98	214.21	6.33	158.67
N_3S_2	62.43	34.69	5.32	225.22	6.49	166.83
N_0S_3	62.76	27.73	3.87	156.12	5.63	77.10
N_1S_3	60.33	35.76	5.42	252.84	7.07	124.87
N_2S_3	58.99	36.66	3.87	264.11	7.21	130.43
N_3S_3	61.33	37.06	5.42	270.95	7.31	133.81
N_0S_4	60.73	28.46	5.50	162.54	5.71	60.20
N_1S_4	58.03	37.39	5.66	302.15	8.08	111.91
N_2S_4	57.03	38.50	4.09	314.17	8.16	116.36
N_3S_4	58.93	39.29	6.54	323.41	8.23	119.78
SE(m)±	**0.250**	**0.308**	**0.122**	**2.553**	**0.023**	**1.900**
CDat 5%	**0.730**	**0.900**	**0.359**	**7.456**	**0.068**	**5.549**

This may be due to the fact that plants absorbed nutrient efficiently and received better light and air exposure under wider spacing. This ultimately might have resulted in the production of more number of flower per plant. The increase in flower yield per unit area under closer spacing was due to the fact that it had a higher plant population in comparison to wider spacing, which could not compensate the decrease in number of plants for total yield. These results are in accordance with the findings of Chanda and Roychauduary (1991), Bhati and Chitkara (1987).

Interaction Effect of Nitrogen and Spacing

The data presented in table 2 also showed that the interaction between nitrogen and spacing levels were found to be significant for most of the flowering and yield character. Among the treatment combination of nitrogen and spacing N_2S_4 (200 kg N/ha x 60x45cm) were recorded earliest flowering (57.03 DAT). While, the maximum value in flowering characters viz; Number of flower per plant (39.29), Flower diameter (6.54 cm), weight of flower (323.41 g), weight of single flower (8.23 g) were recorded under the treatment combination of nitrogen and spacing N_3S_4 (250 kg N/ha x 60x45cm). The treatment combination of nitrogen and spacing N_3S_1 (250 kg N/ha x 30x30 cm) were recorded maximum flower yield/ ha (206.14 q/ha). This was followed by N_2S_1 and N_1S_1 and minimum flower yield/ha was recorded in (N_0S_4). The highest yield was recorded under the interaction of N_3S_1 (250kg N/ha x 30x30 cm) that was significantly superior to the other treatments. The increase weight of flower at wider spacing could be attributed to availability of greater space and light for photosynthesis with higher availability and uptake of nutrients by the plants which could have enhanced cell division, cell elongation as well as protein synthesis and greater accumulation of dry matter in larger sized flower. These results are close conformity with earlier researcher of Kour *et al.,* (2009) in chrysanthemum, Khalaj *et al.,* (2012) in tuberose and Pal and Pandey (2007) in marigold.

Based on the results it may be concluded that the treatment combination comprising of (250 kg N/ha) x (30x30 cm) N_3S_1 spacing should be recommended for the production of yield per unit area in marigold.

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