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EFFECT OF NITROGEN AND PHOSPHORUS LEVELS ON FLOWER YIELD OF MARIGOLD (*TAGETES MINUTA L.*) VAR. VANFOOL

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ABSTRACT
The present investigation was carried out during *Rabi* season in the year 2011-12 and 2012-13 at the Main Experimental Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, (U.P.) with a view to study the effect of nitrogen and phosphorus levels on flower yield of marigold. The maximum yield of flowers of marigold was recorded with the application of 180 kg nitrogen and 120 kg phosphorus/ha. Flower yield/ha increased significantly with increased levels of nitrogen application up to 180 kg N/ha. Maximum flower yield per ha was recorded with the application of 120 kg P/ha followed by 60 kg P/ha. The fresh weight of 100 flowers per plant (g) increased significantly up to the maximum levels with the application of 180 kg N/ha. Further, decrease in level of nitrogen as 120 kg /ha decreased the fresh weight of 100 flowers as compared with 60 kg N /h a.

INTRODUCTION

Genus Tagetes has so many important wild and cultivated plants. Among them, wild marigold (*Tagetes minuta* L.) var. Vanfool is very important member belonging to family Asteraceae. Marigold is one of the important and popular commercial flowers grown mainly for its flowers for making garlands and for other decorative purposes. Nitrogen and phosphorus plays important role in deciding the yield of marigold flowers. It has been observed in many flower crops the nutrient requirements are not consistent. Therefore the nutrient requirement should be supply to crop plant at their various stages of growth and development for attaining the maximum level of yield (Mengal 1969). Nitrogen is well known for its influence on the growth, flower production and quality of bloom in marigold (Noggle and Fritz 1979). Amongst crop production technologies balanced nitrogen and phosphorus fertilization are essential to obtain better plant spread and flower yield per unit area.

Nitrogen and phosphorus are required in sufficient quantities to attain better growth and promote flowering (Pandey and Mishra 2005). Very little work has been done on the nutritional requirements of marigold particularly nitrogen and phosphorus. Therefore the present investigation was conceived and conducted with nitrogen and phosphorus at different levels and combinations to arrive at a feasible nutrient schedule for better flowering and yield potential.

Tagetes minuta is the source of a much priced marigold *essential* oil. All the marigolds belong to the genus *Tagetes* (family Asteraceae tribe Helinieae) whose members are strongly scented species. The genus *Tagetes* is named after *Tagetes* an Etruscan deity who sprang from the earth and revealed the art of the water divining vital forming. It is considered the native to South Africa, but is now found throughout the world. Although, *T. minuta* is long recorded to be grown profusely in India, especially in wild habitats of Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir, the first appraisal of its essential oil composition as made during early sixties. Interests in its domestication and commercial cultivation for essential oil production have been initiated recently. Now the production and sale of *T. minuta* oil have assumed a degree of economic importance in certain rural areas of Indian hills (between1000 to 2500 m) as well as in plains. It is produced as an excellent adjunct to the traditional winter crops. Viewing the importance of *Tagetes minuta* L. var. Vanfool, present study was conducted to find out the optimum level of nitrogen and phosphorus on flower yield of marigold.

MATERIALS AND METHODS

The study site

Systematic experimental procedures were followed during *Rabi* season in the year 2011-12 and 2012-13. The experiment was carried out at the Main Experimental Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), which is located 42 km. away from Faizabad district headquarter on Faizabad - Raebareli Road. The soil analysis was done in the Laboratory of Department of Soil Science and Agricultural Chemistry and Department of Horticulture of this University.

Geographical condition

Geographically, the site of experimentation is situated at 26.47º North latitude and 82.12ºeast longitude at an altitude of 113 meters above the mean sea level. Kumarganj, Faizabad experiences sub–tropical climate of Indo-Gangetic plains of Eastern Uttar Pradesh (India) with hot dry summers and cool winters.

Climatic condition

The mean annual rainfall was recorded 1280 mm and relative humidity 63.15%. The rainfall was erratically distributed. Both maximum and minimum temperatures were found to fluctuate throughout the crop growth period. In general, the maximum temperature declined from time of transplanting to the third week of January and thereafter, increasing trends were recorded up to the termination of crop. The fluctuations were from 19.25ºC to 41.87ºC. The lowest and highest minimum temperature were recorded in first week of February and first week of May. The fluctuations were from 6.02ºC to 25.14ºC. The total rainfall received during crop season 57.21 mm. The meteorological observations recorded during the course of experimentation from October, 2011-12 to April, 2012-13.

Soil sampling

In order to determine the physic–chemical properties of the soil and its fertility status, the soil samples were collected randomly from the different places of the field with the help of soil auger in each of the three replications to a depth of 0-15 cm after the land preparation and before application of fertilizers.

Experimental details

The soil samples from each replication were mixed together and a composite sample was drawn and analyzed. Factorial Randomized Block Design with three replications and twelve treatments having thirty six plots of the size 2.4 X 1.8 m were included in the experiment. Plant spacing was 40 × 30 cm. Variety chosen for present study was 'Vanfool'. Season of experiment was *Rabi* 2011-12 and 2012-13. Date of nursery and date of transplanting were 5th October and 11th November, respectively. Four levels of nitrogen (N_0, N_{60}, N_{120} and N_{180} kg/ha) and three levels of phosphorus (P_o, P_{60} and P_{120} kg/ha) were applied for conducting the research. Viewing the precious and different use of fresh and processed wild marigold under present study, number of flowers / plant; weight of 100 flowers; flower yield / plant and flower yield /ha were measured with the application of different levels of nitrogen and phosphorus.

Statistical analysis

The data recorded during the course of investigation was subjected to statistical analysis described by Panse and Sukhatme (1985). The significance and non-significance of treatment effect was judge with the help of 'F' (variance ratio) table. The significance differences between the mean were tested against the critical difference at 5% probability level.

RESULTS AND DISCUSSION

The analysis of data received on different segments of the study was done thoroughly, which is presented below:

Number of flowers per plant

The data recorded on average number of flowers per plant in marigold is presented in Table 1 for the year 2011-12 and 2012-13, which show that application of nitrogen significantly and phosphorus non-significantly influenced the number of flowers per plant. The number of flowers per plant increased significantly with increasing the levels of nitrogen. Maximum number of flowers per plant (3121.11 during 2011-12 and 3840.22 during 2012-13) was recorded with application of 180 kg N/ha followed by 2701.00 during 2011-12 and

Table 1: Effect of nitrogen and phosphorus levels on number of flowers per plant in *Tagetes minuta*

Levels of nitrogen	Levels of phosphorus 2011-12			Mean	Levels of phosphorus 2012-13			Mean
	P_0	P_1	P_2		P_0	P_1	P_2	
N_0	1503.67	2023.33	1324	1617	1511.67	2031.33	1332	1625
N_1	2168.33	2584	2957.67	2570	2177.67	2590.67	2967	2578.44
N_2	2414	2455.67	3234.67	2701	2422	2462.33	3242.67	2709
N_3	2478	3522	3363.33	3121.11	3530	3371.33	4619.33	3480.22
Mean	2142	2646.25	2719.92	-	2613.19	2653.58	3290.25	-
	N		-	P		-	N× P	
	2011-12	2012-13	-	2011-12	2012-13	-	2011-12	2012-13
CD (P=0.05)	840.78	491.57	-	NS	NS	-	NS	NS

Table 2 : Effect of nitrogen and phosphorus levels on weight of 100 flowers (g) of *Tagetes minuta*

Levels of nitrogen	Levels of phosphorus 2011-12			Mean	Levels of phosphorus 2012-13			Mean
	P_0	P_1	P_2		P_0	P_1	P_2	
N_0	1.3	1.31	1.57	1.39	1.42	1.45	1.62	1.49
N_1	1.46	1.57	1.54	1.52	1.58	1.7	1.68	1.65
N_2	1.58	1.55	1.56	1.56	1.69	1.71	1.72	1.7
N_3	1.59	1.56	1.71	1.62	1.74	1.77	1.79	1.76
Mean	1.48	1.49	1.59	-	1.6	1.65	1.7	-
	N		-	P		-	N× P	
	2011-12	2012-13	-	2011-12	2012-13	-	2011-12	2012-13
CD (P=0.05)	0.045	0.047	-	0.039	NS	-	NS	NS

Table 3 : Effect of nitrogen and phosphorus levels on flower yield/ plant (g) of *Tagetes minuta*

Levels of nitrogen	Levels of phosphorus 2011-12			Mean	Levels of phosphorus 2012-13			Mean
	P_0	P_1	P_2		P_0	P_1	P_2	
N_0	21.2	25.6	31.93	26.24	23.2	27.6	33.93	28.24
N_1	34.67	33.5	37.1	35.09	37	35.83	38.77	37.2
N_2	44.3	44.13	45.97	44.8	45.4	42.15	43.13	43.56
N_3	49.8	57.87	62	56.56	51.8	59.87	64	58.56
Mean	37.49	40.27	44.25	-	39.35	41.36	44.95	-
	N		-	P		-	N× P	
	2011-12	2012-13	-	2011-12	2012-13	-	2011-12	2012-13
CD (P=0.05)	12.19	12.1	-	NS	NS	-	NS	NS

Table 4: Effect of nitrogen and phosphorus levels on flower yield/ ha (q) of *Tagetes minuta*

Levels of nitrogen	Levels of phosphorus 2011-12			Mean	Levels of phosphorus 2012-13			Mean
	P_0	P_1	P_2		P_0	P_1	P_2	
N_0	15.9	19.2	23.95	19.68	17.4	20.7	25.45	21.18
N_1	25.98	25.12	27.82	26.3	26.87	27.75	29.07	27.89
N_2	34.83	37.95	36.8	36.52	36.35	35.8	34.85	35.66
N_3	37.35	43.4	46.5	42.41	38.85	44.9	48	43.92
Mean	28.51	31.41	33.76	-	29.86	32.28	34.34	-
	N		-	P		-	N× P	
	2011-12	2012-13	-	2011-12	2012-13	-	2011-12	2012-13
CD (P=0.05)	9.26	8.85	-	NS	NS	-	NS	NS

2709.00 during 2012-13 with the application of 120 kg N/ha and 2570.00 during 2011-12 and 2578.44 during 2012-13 was recorded with the application of 60 kg N/ha.The application of phosphorus had shown non-significant effect on number of flowers per plant of marigold and maximum values for number of flowers per plant (2719.92during 2011-12 and 3290.25 during 2012-13) was recorded due to the application of 120 kg P/ha followed by (2646.25 during 2011-12 and 2653.58 during 2012-13) was recorded with application of 60 kg P/ha and 2141.00 during 2011-12 and 2613.91 during 2012-13 under controlled plots. Similar type finding was reported by Yadav *et al.,* 2000. The interaction effect of nitrogen and phosphorus was found non- significant. The maximum number of flowers per plant (3363.33 during 2011-12 and 4619.33 during 2012-13) was recorded with the application of 180 kg N/ha along with 120 kg P/ha and the minimum number of flowers per plant was observed in the treatment where no fertilizers were given (N_0P_0). Such findings were partially supported by Garhwal *et al*., 2014; Kumar *et al.,* 2003.

Weight of 100 flowers per plant (g)

A perusal of data shown in Table 2 for the year 2011-12 and 2012-13 clearly indicates that the application of phosphorus non-significantly and nitrogen significantly influenced the fresh weight of 100 flowers per plant (g). The fresh weight of 100 flowers per plant (g) increased significantly up to the maximum levels due to the application of 180 kg N/ha. Further, decrease in level of nitrogen as 120 kg N/ha decreased the fresh weight of 100 flowers as compared with 60 kg N /ha. Phosphorus application had a shown non-significant influence on fresh weight of 100 flowers per plant. Maximum average fresh weight of 100 flowers per plant (1.59 g during 2011-12 and 1.79 g during 2012-13) was recorded with the application of 120 kg P/ha followed by (1.49 g during 2011-12 and 1.65 g during 2012-13) was recorded with the application 60 kg P/ha. The interaction effect between nitrogen and phosphorus application did not found significant effect on increase of fresh weight of 100 flowers per plant. Maximum fresh weight of 100 flowers per plant (1.71 g during 2011-12 and 1.79 g during 2012-13) was recorded with the application of 180 kg N/ha in combination with 120 kg P/ha. Such findings were supported by Anwar *et al.,* 2010.

Flower yield/plant (g)

Data pertaining to Flower yield/plant (g) as influenced by different treatments are presented in Table 3 for the year 2011-12 and 2012-13. Data recorded on Flower yield/plant indicate that it increased significantly with increased levels of nitrogen application up to 180 kg N /ha and thereafter, decreased gradually with decreased dose of nitrogen 120kg P/ha. In case of phosphorus application, it was found that increasing levels of phosphorus non-significantly increased the flower yield /plant. Maximum flower yield per/plant (44.25 g during 2011-12 and 44.95 g during 2012-13) was recorded with the application of 120 kg P/ha, followed by (40.27 g during 2011-12 and 41.36 g during 2012-13) was recorded with application of 60 kg P/ha. The interaction effect between nitrogen and phosphorus application was not found significant. However, maximum flower yield per plant (62.00 g during 2011-12 and 64.00 g during 2012-13) was recorded with the application of 180kg N/ha and 120 kg P/ha. These findings were found at par to the studies done by Kundu *et al.,* 2010; Polara *et al.*, 2014; Mohanty *et al.,* 2013 and Nagaich *et al.,* 2003.

Flower yield/ha (q)

Data pertaining to flower yield/ha (q) as influenced by different treatments are presented in Table 4 for the year 2011-12 and 2012-13. The observations recorded on flower yield/ha indicate that the flower yield /ha increased significantly with increased levels of nitrogen application up to 180 kg N\ha and thereafter, decreased with the lower dose of nitrogen

120 kg /ha. In case of phosphorus application, it was found that increasing levels of phosphorus significantly increased the flower yield per/ha. Maximum flower yield per/ha (33.76 q/ha during 2011-12 and 34.34 q/ha during 2012-13) was recorded with the application of 120 kg p/ha fallowed by 31.41 q/ha during 2011-12 and 32.28 q/ha during 2012-13) with the application of 60 kg P/ha. Arulmozhiyan and Pappaiah (1989) stated that the increased flower production might be due to increased 46 content of available nitrogen which promotes better vegetative growth and enhance production. Arora and Khanna (1986) and Anuradha *et al*. (1988b) also reported significant increase in flower production due to nitrogen application. The interaction effect between nitrogen and phosphorus application was not found significant. However, maximum flower yield/ha (46.50 q/ha during 2011-12 and 48.00 q/ha during 2012-13) was recorded with the application of 180kg N/ha and 120 kg P/ha. This study was supported by Karuppaiah and Krishna, 2005; and Mohanty *et al.,* 2013**.**

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