Ann. Pl. Soil Res. 14(2): 153-155 (2012)

EFFECT OF PLANT DENSITIES, NITROGEN AND PHOSPHORUS LEVELS ON GROWTH, YIELD AND QUALITY OF AFRICAN MARIGOLD

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Received: May, 2012

ABSTRACT

A field experiment was conducted during winter season of 2006-07 at Jabalpur to study the effect of plant densities, nitrogen and phosphorus levels on yield and quality African marigold cv. Pusa Narangi Gainda. Leaves/plant, fresh weight of flower, weight of flowers/plant and yield of flowers per hectare were found significant due to treatment interactions. The closer plant density of 50 x 40 cm alongwith nitrogen and phosphorus each @ 100 kg ha^{-1} decreased the leaves/plant (161), fresh weight of flower (12.20 g) and weight of flowers/plant (286.7 g) but increased the yield of flowers upto maximum (143.35 q ha^{-1}) with net return upto Rs.81570 ha^{-1} and B:C ratio 3.46. Shelf life of flowers enhanced due to wider (50 x50 cm) spacing and higher P levels.

Keywords: Plant densities, nitrogen, phosphorus, African marigold

INTRODUCTION

Marigold is one of the most important commercially exploited flower crops in India. Amongst the crop production technology, appropriate spacing between plants and balanced N and P fertilization are essential to obtain better plant spread and flower yield per unit area. Studies indicated that optimum plant spacing provided favourable conditions to flourish the crop for higher flower yield (Karuppaiah and Krishna, 2005). Similarly, N and P are required in sufficient quality to attain better growth and promote flowering (Pandey and Mishra, 2005). In fact, an adequate supply of N results in vigorous growth of the plant hence yield of flowers with better quality. Phosphorus is needed for normal growth and development of the plants due to its vital role in chlorophyll synthesis and involvement in various physiological and metabolic processes of the plant. Research work on these aspects is meager; hence the present experiment was taken up to achieve the maximum productivity of marigold flowers.

MATERIALS AND METHODS

The field experiment was carried out at the new nursery of the J. N. Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during winter season of 2006-07. The soil was sandy clay-loam having pH 7.2, organic carbon 6.8 g kg^{-1}, available N, P_2O_5 and K_2O 155, 13 and 339 kg ha^{-1}, respectively. The treatments comprised two planting densities (50 x 50 and 50 x 40 cm), three N levels (0, 50 and 100 kg ha^{-1}) and three P levels (0, 50 and 100 kg ha^{-1}). The eighteen treatment combinations were laid out in a factorial randomized block design with three replications. Half dose of N and full dose of P were applied as basal through urea and single superphosphate, respectively. The remaining half dose of N was top-dressed at 20 and 40 days after transplanting. FYM @ 30 t ha^{-1} was applied uniformly at the time of land preparation. Potassium @ 50 kg ha^{-1} was also applied uniformly as basal through muriate of potash. Thirty days old seedlings of marigold var. Pusa Narangi Gainda was transplanted on 6 November, 2006 in plots having 2.5 m x 2.0 m size. All other field operations were performed as per recommended package of practices. Plucking of flowers was done five times between 27 January to 18 March, 2007. The leaf chlorophyll content was estimated by spectrophotometric method (Yoshida *et al*., 1972).

RESULTS AND DISCUSSION

Growth and chlorophyll content

Closer spacing (50 x 40 cm) enhanced the plant height significantly whereas wider spacing (50 x 50 cm) increased the other growth parameters including chlorophyll contents in leaves (Table 1). Widely spaced plants faced less competition for space, moisture, light and thereby received more nutrition over narrowly spaced plants to satisfy their requirement for better growth. Production of significantly taller plants under closer spacing (50 x 40 cm) has also been reported by Jadhav *et al.* (2002) and Karuppaiah and Krishna (2005). Similarly, the beneficial effect of wider spacing on plant spread leaves and branches/plant has also been reported by Karavadia and Dhoduk (2002) and Khalaj *et al.* (2012). The increasing N and P levels upto 100 kg ha^{-1} increased the growth parameters and chlorophyll content significantly. Nitrogen nutrient plays a vital role in the plants and effects physiological activities in various ways. It is a constituent of protoplasm, chlorophyll“a”,“b” and nucleic acids. One of the main

Table 1: Growth, yield and quality of marigold as influenced by plant densities, nitrogen and phosphorus levels

Treatments	Plant height (cm)	Plant spread (cm) N-S	Plant spread (cm) E-W	Leaves / plant	Branches/ plant	Circum-ference of flowers (cm)	Fresh weight of flower (g)	Flowers/ plant	Weight of flowers/ plant (g)	Yield of flowers (q/ha)	Chlorophyll (mg/g fresh leaf weight "a"	Chlorophyll (mg/g fresh leaf weight "b"	Shelf life of flowers (days)	Net income (Rs./ha)	Benefit: cost ratio
Plant densities															
(50 x 50 cm)	99.30	61.95	66.32	162.0	38.21	21.84	9.98	21.28	214	85.67	0.561	0.179	8.80	36996	2.10
(50 x 40 cm)	101.62	58.76	64.82	144.1	34.51	21.30	9.73	21.91	213	107.08	0.452	0.132	8.34	54124	2.70
C.D. (P=0.05)	0.56	1.87	NS	1.33	1.20	NS	0.020	0.51	NS	1.42	0.002	0.0016	0.39	--	--
N-levels (kg/ha^{-1})															
0	94.67	57.54	61.60	140.6	32.56	20.44	8.54	21.06	177	80.38	0.425	0.128	8.69	33317	2.07
50	100.39	60.43	66.42	155.0	36.10	21.27	9.54	21.18	204	92.04	0.498	0.150	8.74	42095	2.33
100	106.43	63.10	68.71	163.6	40.43	23.00	11.48	22.54	260	116.70	0.597	0.189	8.28	61268	2.90
C.D (P=0.05)	0.69	2.29	2.69	1.63	1.47	1.00	0.023	0.62	205	1.73	0.002	0.0019	NS	-	--
P-levels (kg/ha^{-1})															
0	97.97	59.41	63.67	151.7	34.93	20.78	9.31	20.88	196	88.93	0.452	0.134	7.99	40619	2.33
50	100.73	59.95	64.42	153.2	36.14	21.57	9.86	21.40	208	93.94	0.530	0.166	8.77	43610	2.37
100	102.79	61.71	68.63	154.3	38.02	22.35	10.40	22.52	236	106.26	0.538	0.167	8.94	52452	2.60
C.D (P=0.05)	0.69	NS	2.69	1.63	1.47	1.00	0.023	0.62	2.5	1.73	0.002	0.0019	0.47	--	--

main functions of nitrogen is the initiation of meristematic activity of plants. The cell division and cell enlargement are also accelerated by ample supply of nitrogen. Thus, the growth of plant by and large depends on nitrogen. Similarly, phosphorus is also an essential element which occupies a key position in energy transportation in fat and protein metabolism. The availability of phosphorus has been associated with the development of roots and early maturity of crops. The present findings are in consonance with those of Kumar *et al.* (2002), Sehrawat *et al.* (2003), Pandey and Mishra (2005). The effects of treatment interactions were found significant only in case of number of leaves/plant and chlorophyll contents in leaves.

Yield-attributes and yield

Plant densities did not deviate the circumference of flowers and weight of flowers/plant significantly; however, fresh weight of flower was significantly higher due to wider 50 x 50 cm spacing while number of flowers/plant was significantly higher due to closer 50 x 40 cm spacing. The yield of flowers was significantly higher (107.08 q/ha) under closer spacing (50 x 40 cm) over wider spacing (50 x 50 cm) i.e. 85.67 q/ha. This was due to increased number of flowers/plant as well as increased plant population per hectare under closer spacing. The highest N and P level (!00 kg ha^{-1}) produced significantly higher yield of flowers (116.70 and 106.26 q ha^{-1}, respectively) over the lower N and P levels Yield of flower crops depend on the amount of vegetative growth. The increase in flower yield might be attributed to increased supply of major nutrients like N and P which played their unique functions in the growth and development of plants. These results are in conformity with those of Baboo and Singh (2003) and Gaikwad *et al.* (2004). The treatment interactions were found almost significant in case of yield and yield attributes (Table 2). The closer spacing with 100 kg ha^{-1} N and P decreased the leaves/plant, fresh weight of flower and weight of flowers/plant but increased the yield of flowers upto maximum (143.35 q ha^{-1}) with net return upto Rs.81570 ha^{-1} and B:C ratio 3.46. In fact, closer spacing created competition between plants for light, space, moisture and nutrients thereby decreased the yield-attributes, however yield increase was due to increased plant population per unit area.

Table 2: Growth and yield of marigold as influenced by treatment interactions (spacing x N x P levels)

Treatment	N_0P_0	N_0P_{50}	N_0P_{100}	$N_{50}P_0$	$N_{50}P_{50}$	$N_{50}P_{100}$	$N_{100}P_0$	$N_{100}P_{50}$	$N_{100}P_{100}$	CD at5%
Number of leaves/plant										
50 x 50 cm	141.13	143.53	151.33	156.76	152.00	180.62	174.40	176.20	184.40	5.64
50 x 40 cm	128.66	129.53	149.53	142.33	156.46	137.86	143.46	148.00	161.00	
Fresh weight of flower (g)										
50 x 50 cm	8.45	8.63	8.86	9.25	9.55	10.11	10.48	11.85	12.70	0.08
50 x 40 cm	8.30	8.43	8.60	9.10	9.30	9.95	10.29	11.38	12.20	
Weight of flowers/plant (g)										
50 x 50 cm	165.70	177.08	185.52	197.23	194.46	2`9.79	226.36	245.65	314.75	8.57
50 x 40 cm	176.25	171.88	184.90	187.09	200.56	227.55	223.49	260.14	286.70	
Flowers yield (q/ha)										
50 x 50 cm	66.29	70.83	74.21	78.88	77.91	87.91	90.54	98.62	125.89	6.00
50 x 40 cm	85.94	92.62	92.45	93.54	100.28	113.77	111.74	130.07	143.35	

Shelf life and economics

The closer spacing (50 x 40 cm) decreased the shelf life of flowers but increased the net income upto Rs.54124 ha^{-1} with B:C ratio 2.70. Applied N levels did not deviate the shelf life of flowers, however it was minimum (8.28 days) under 100 kg N ha^{-1}, whereas under100 kg P_2O_5 ha^{-1} it was maximum (8.94 days).

The highest N and P level (100 kg ha^{-1}) brought about highest net income i.e. Rs.61268 and and Rs.52452 ha^{-1}, respectively. The corresponding B:C ratio was 2.90 and 2.60. This net income was higher by Rs.27951 and Rs.11833 ha^{-1} in comparison to without N and P, respectively.

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