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Response of African marigold cv. Siracole to organic and inorganic nitrogen sources

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ABSTRACT

Field experiment was conducted to investigate the effect of different levels and sources of nitrogenous fertilizer on African marigold (*Tagetes erecta* Linn.) cv. Siracole, on sandy loam soil. Plant height, number of both primary and secondary branches, flower diameter, individual flower weight and flower yield were directly related to nitrogen level. Flower yield increased significantly with increase in nitrogen fertilization from 100 to 200 kg N ha^{-1}. Sources of nitrogen significantly influenced the vegetative as well as flowering attributes. Application of 50% N as mustard oil cake as basal + 50% N as urea as top dress recorded highest value for different parameters recorded, including chlorophyll content in leaf tissues and anthocyanin in petals, except plant height. While, treatment 100% N as neem oil cake recorded minimum values in all parameters. Amongst various interactions, application of 300 kg N ha^{-1} in the form of 50% as N as mustard oil cake as basal + 50% N as urea as top dressed recorded maximum flower yield and heaviest flower but was at par with 200 kg N ha^{-1} in the form of 50% N as mustard oil cake as basal + 50% N as urea as top dressed.

Key words: African marigold, nitrogen, chlorophyll, anthocyanin.

INTRODUCTION

Production of any crop is normally influenced by the genetic, edaphic and environmental factors. Farmers of developing countries need greater productivity from their land; therefore, proper soil management is indispensable in this respect. Organic sources of nutrition influence favarouble the plant growth and yield directly or indirectly. Humic substances present in soil also increase the efficiency of bio- and chemical fertilizers. The concept of integrated nutrient supply involving combined use of organic and chemical fertilizers has also been developed. The use of adequate doses of organic nutrition coupled with chemical fertilizers will ensure optimum growth and yield under intensive farming system. Moreover, meager information is available about the response of marigold to organic and inorganic sources of nitrogen alone or in combinations. Keeping this in view, a study was undertaken to evaluate the growth, yield, and quality of African marigold cv. Siracole as influenced by nitrogen levels and sources.

MATERIALS AND METHODS

A field experiment was laidout in sandy loam soil (pH 6.2, organic carbon 0.47%, 150 kg available nitrogen, 82.4 kg available phosphorus and 110 kg available potassium ha^{-1}) at Horticulture Research Farm, Mandauri, BCKV, Nadia, under irrigated conditions adopting randomized block design with three replications for two years (September to March during 2002 to 2004). Three levels of nitrogen *viz.,* N_1 -100 kg ha^{-1}, N_2 - 200 kg ha^{-1} and N_3 - 300 kg ha^{-1} was applied through organic and inorganic sources *viz.,* mustard oil cake (5.2% N), neem oil cake (5.1% N) and urea (46% N). Treatment details are: T_1 - 50% N as urea + 50% N as urea, T_2 - 50% N as mustard oil cake + 50% N as mustard oil cake, T_3 - 50% N as neem oil cake + 50% N as neem oil cake, T_4 - 75% N as neem oil cake + 25% N as urea, T_5 - 50% N as neem oil cake + 50 % N as urea, T_6 - 25% N as neem oil cake + 75% N as urea, T_7 - 75% N as mustard oil cake + 25% N as urea, T_8 - 50% N as mustard oil cake + 50 % N as urea, T_9 - 25% N as mustard oil cake + 75% N as urea. Nitrogen was applied as basal and top dress. Twenty seven treatment combinations were evaluated.

The experimental plot size was laid out with an area of 5.76 m^2 (2.4 m × 2.4 m). A basal dose of 80 kg P_2O_5 ha^{-1} and 80 kg K_2O ha^{-1} was applied. Well rooted terminal cuttings of 21 to 25-day-old with more or less uniform growth and vigour were planted at a spacing of 40 cm × 30 cm and adopted with uniform agronomical practices for all treatments. Nitrogen was applied according to the treatment combinations as mentioned in treatment schedule. Top dressing was given 25 days after planting. To encourage axillary branches plants were pinched at 20 days after planting.

Leaf samples were collected randomly at pre-blooming stage (40 days after planting) in each treatment for estimation of N, P, K and chlorophyll

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contents in leaves. Total N content was measured by Kjeldal procedure. Phosphorus was measured by spectrophothometric method and K by atomic absorption-spectro photomeler. Chlorophyll was extracted in 80% acetone and quantified by measuring their absorbance at 645 and 663 nm, using a spectrophotometer and the chlorophyll content was calculated using the equation described by Witham *et al.* (10). At the peak flowering stage, flower petals were collected randomly in each treatment for anthocyanin estimation. The alcoholic extract of the sample was treated with HCl in aqueous methanol followed by anthocyanin reagent [Mix 1 ml of 30% H_2O_2 with 9 ml of methanolic-HCl (5:1, 3N)]. Anthocyanin was measured spectrophotometrically at 445 nm (Wellburn, 9).

Observations were recorded on morphological parameters *viz.*, plant height, number of primary and secondary branches per plant, flower diameter, individual flower weight and flower yield. The data on crop characters and yield were pooled over two years and analyzed statistically (Panse and Sukhatme, 8).

RESULTS AND DISCUSSION

In the present study, the mean plant height, number of primary and secondary branches per plant, flower diameter and individual flower weight and flower yield of African marigold increased with increase in nitrogen fertilization from 100 to 300 kg ha^{-1} (Table 1). The present work is in confirmation with findings of Acharya and Dashora (1) in African marigold. The beneficial effect of nitrogen application in promoting the vegetative growth and flowering of marigold plant could be explained from the fact that N is the major constituent of proteins, amino acids and chlorophyll and its synthesis is accelerated with application of nitrogen, which is helpful in plant growth (Haque and Jakhro, 5).

Different nitrogenous fertilizers alone or in combination significantly influenced all vegetative and flowering attributes of African marigold. Treatment with 25% N as mustard oil cake along with 75% N as urea (T_9) recorded maximum linear growth of plants. Application of 50% N as mustard oil cake along with 50% N as urea (T_8) was outstanding for other vegetative and flowering attributes. Plants under T_3 (100% N as neem oil cake) showed poor performance in all respects. The beneficial effect of combined application of mustard oil cake and urea was possible as because the oil cake not only supplied nitrogen but also contained micronutrients. Oil cake contains some percentage of oil, which prevents rapid conversion of organic nitrogen into available form. A mixture of organic and inorganic nitrogenous fertilizers was very effective in African marigold (Basantia *et al.,* 2). Plants treated with full dose of nitrogen as neem oil cake proved less effective compared to other treatments. Das and Mukherjee (3) noticed the adverse effects of neem cake on beneficial organisms present in the soil. Mukherjee *et al.* (7) observed that neem oil cake caused an accumulation of ammoniated nitrogen in the soil during inhibition of nitrification and increase in soil pH. Devakumar and Riar (4) considered it due to bioregulators like meliacins, epinimbin, salin and azadirachtin. The interaction between different levels and sources of nitrogen showed marked variation in growth, flowering and yield of African marigold. Application of 50% N as mustard oil cake and 50% N as urea (T_8), irrespective of levels significantly increased the flowering parameters and yield per plot. However, application of 300 kg N ha^{-1} as 50% as mustard oil cake and 50% as urea (N_3 T_8) appreciably influenced the vegetative and flowering as well as yield attributes in both the years of investigation.

Nitrogen, phosphorous and potassium content in leaf tissues increased with each increment of nitrogen application in soil in both the years of investigation (Table 2). Maximum N and K content was recorded with the higher levels of nitrogen (300 kg N ha^{-1}). Yadav *et al.* (11) also noted similar findings in African marigold. Application of nitrogen in the form of 25% N as mustard oil cake along with 75% N as urea (T_9) recorded maximum nitrogen content (3.55%) in leaf issues, whereas minimum (2.71%) with T_3 (100% N as neem oil cake). However, phosphorus (0.31%) and potassium (4.36%) were maximum when nitrogen was applied as 50% N as mustard oil cake along with 50% N as urea (T_8).

Synthesis of chlorophyll in leaf tissues and anthocyanin content (Table 2) in flower petals are also influenced by exogenous application of nitrogen in soil. The results are in accordance with the findings of Hussein and Kamel (6) in *Amaranthus tricolor.* It may be due to the fact that chlorophyll synthesis is markedly accelerated by exogenous application of nitrogenous fertilizer. Maximum synthesis of chlorophyll (1.38 mg/ g) in leaf tissue and anthocyanin (0.64 mg/100 g) content in flower petals were recorded under T_8 (50% N as mustard oil cake + 50 % N as urea), whereas minimum under T_3 (100% N as neem oil cake).

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Table 1. Effect of different levels and sources of N on plant height, branch number, flower diameter, individual flower weight and yield of African marigold cv. Siracole.

Treatment	Plant height (cm)	No. of primary branches/ plant	No. of secondary branches/ plant	Flower dia. (cm)	Individual flower wt. (g)	Flower yield (kg / 5.76 sq.m.)
N level						
N_1	50.47	4.93	19.82	5.29	4.92	16.10
N_2	60.12	5.38	21.40	5.58	5.27	19.67
N_3	67.87	5.53	21.97	5.68	5.44	21.43
CD at 5%	1.31	0.07	0.14	0.04	0.21	1.85
N source						
T_1	65.39	5.32	20.98	5.57	5.23	19.53
T_2	45.35	4.62	18.87	5.10	4.64	12.93
T_3	42.52	4.52	18.14	4.92	4.54	10.47
T_4	58.94	4.89	19.88	5.31	4.92	16.96
T_5	61.28	5.54	21.99	5.69	5.39	21.15
T_6	67.23	5.17	20.68	5.50	5.13	18.86
T_7	61.28	5.59	22.22	5.69	5.47	21.76
T_8	64.18	6.03	23.70	6.00	5.83	26.03
T_9	69.22	5.84	23.09	5.88	5.72	24.20
CD at 5%	2.26	0.12	0.25	0.07	0.36	3.21
Interaction effect						
N_1T_1	53.05	4.78	19.27	5.18	4.75	14.45
N_1T_2	42.57	4.56	18.67	5.03	4.58	11.77
N_1T_3	40.27	4.47	17.85	4.86	4.49	9.44
N_1T_4	48.56	4.78	19.52	5.25	4.80	15.71
N_1T_5	51.15	5.10	20.37	5.46	5.14	18.49
N_1T_6	57.75	4.90	19.93	5.30	4.97	17.48
N_1T_7	49.25	5.00	20.08	5.35	5.02	17.48
N_1T_8	52.36	5.57	22.00	5.72	5.37	21.06
N_1T_9	59.20	5.17	20.67	5.48	5.15	18.98
N_2T_1	66.43	5.42	21.40	5.68	5.30	20.41
N_2T_2	45.74	4.63	18.93	5.12	4.65	13.04
N_2T_3	42.20	4.55	18.12	4.92	4.56	10.71
N_2T_4	59.88	4.88	19.83	5.27	4.86	16.50
N_2T_5	61.17	5.65	22.38	5.76	5.40	21.56
N_2T_6	68.59	5.25	29.93	5.56	5.19	19.27
N_2T_7	62.44	5.80	22.85	5.80	5.53	22.52
N_2T_8	64.42	6.17	24.22	6.07	6.01	27.27
N_2T_9	70.23	6.10	23.92	6.02	5.94	25.75
N_3T_1	76.70	5.75	22.27	5.85	5.65	23.72
N_3T_2	47.72	4.67	19.02	5.15	4.69	13.99
N_3T_3	45.08	4.55	18.45	4.96	4.57	11.25
N_3T_4	68.37	5.02	20.28	5.41	5.08	17.84
N_3T_5	71.52	5.87	23.22	5.84	5.64	23.39
N_3T_6	75.35	5.35	21.17	5.63	5.24	19.83
N_3T_7	72.14	5.97	23.73	5.93	5.87	25.27
N_3T_8	75.75	6.35	24.88	6.21	6.11	29.74
N_3T_9	78.22	6.27	24.68	6.15	6.06	27.87
CD at 5%	3.92	0.21	0.43	0.13	0.62	5.56

Table 2. Effect of different levels and sources of N on N, P, K and chlorophyll content in leaf tissue and anthocyanin in petals of African marigold cv. Siracole.

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Chlorophyll (mg / g)	Anthocyanin (mg / 100 g)
N Level					
N_1	2.69	0.24	3.76	1.16	0.47
N_2	3.23	0.27	3.84	1.25	0.53
N_3	3.67	0.28	3.89	1.28	0.56
N sources					
T_1	3.49	0.24	3.19	1.25	0.52
T_2	2.78	0.21	3.27	1.08	0.41
T_3	2.71	0.19	3.21	1.05	0.38
T_4	3.05	0.29	4.09	1.15	0.46
T_5	3.29	0.27	4.18	1.31	0.55
T_6	3.35	0.29	3.84	1.23	0.51
T_7	3.15	0.30	4.31	1.29	0.58
T_8	3.42	0.31	4.36	1.38	0.64
T_9	3.55	0.29	4.02	1.34	0.61

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