

Influence of nitrogen and phosphorus on flowering, N and P content of African marigold, *Tagetes erecta* L var Cracker Jack

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ABSTRACT

A field investigation was conducted to study the influence of nitrogen and phosphorus on flowering, N and P content of African marigold. The results revealed that among four levels of nitrogen highest level of nitrogen (200 kg N/ha) took significantly minimum days to complete flowering (50.66 days) and the treatment of 150 kg N/ha recorded significantly higher number of flower heads per plant (28.42), size of the flower head (5.59 cm), fresh weight of the flower heads per plant (71.25 g) and yield (11.11 t/ha). The days to full flowering were earlier (51.41 days) in the treatment without phosphorus. However number of flower heads per plant (28.30), size of flower head (5.74 cm), fresh weight of the flower heads per plant (69.65 g) and yield (10.80 ton/ha) was higher in the treatment of 200 kg P/ha. While studying the interaction effect of nitrogen x phosphorus the combination of highest level of nitrogen (200 kg N/ha) without phosphorus recorded early flowering (50.00 days). Number of flower heads per plant (31.83), fresh weight of the flower heads per plant (75.13 g) and yield (11.65 t/ha) were higher in treatment combination of 200 kg N/ha and 200 kg P/ha. The content of nitrogen and phosphorus and their combinations increased as their levels increased. Significant and positive correlation was observed between yield and other parameters.

Keywords: Marigold; nitrogen; phosphorus; flowering; N; P

INTRODUCTION

Marigold is one of the important and popular commercial flowers grown mainly for its flowers for making garlands and for other decorative purposes. The crop has its specific requirement of N and P. It has been established that the nutrient requirements of many of flower crops are not consistent. Hence the nutrient supply should be adjusted

to the specific requirements of plants during various stages of growth to attain 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 N and P 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 under the tropical conditions of semi-arid zone of southern Andhra Pradesh. 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 under the prevailing agro-climatic conditions of Tirupati an important town of southern Andhra Pradesh which falls under semi-arid tropical zone.

MATERIAL and METHODS

The experiment was conducted at the Horticultural Garden, Sri Venkateswara Agricultural College, Tirupati, AP during 2000-2001. The soil of the experimental area was red sandy loam with good drainage and low water holding capacity. Soil samples were collected before applying manures at a depth of 20 cm from the experimental area from randomly selected spots. The composite sample was analysed for its chemical characteristics, nitrogen, phosphorus and potassium content. Chemical analysis of soil indicated that the soil was low in nitrogen and available phosphorus and high in available potash and alkaline in nature. African marigold var Cracker Jack was selected for the study.

Raised nursery beds of 3 x 0.5 m size were prepared well in advance for sowing seeds. The seeds were treated with 0.30 per cent Captan before sowing. Two hundred kilogram of farm yard manure as basal dose was applied and mixed well in the soil at the time of last ploughing and the nutrients were applied in the form of urea (46.4%) and superphosphate (16.0% P_2O_5). The entire quantities of phosphorus, potash and 50 per cent nitrogen were applied as basal dose and remaining 50 per cent nitrogen was applied as top dressing three weeks after transplanting in the main field. Thirty days old healthy seedlings of uniform growth were used for transplanting at 40 x 40 cm spacing. All other field operations were performed as per recommended package of practices.

The treatments comprised of N levels N_0 (0 kg N/ha), N_1 (100 kg N/ha), N_2 (150 kg N/ha) and N_3 (200 kg N/ha) and P levels P_0 (0 kg P/ha), P_1 (100 kg P/ha) and P_2 (200 kg P/ha). The experiment was laid out in factorial randomized block design with three replications. Data on days to complete flowering, number of flower heads per plant, fresh weight of the flower heads, yield and N and P contents were recorded and analyzed. Fishers (1963) method of analysis of variance was adopted for the analysis and interpretation of the data. 'F' and 't' tests were applied and the results were tabulated and interpreted in the light of the statistical analysis.

RESULTS and DISCUSSION

Days to full flowering

A perusal of the data in Table 1 indicates that among different nitrogen levels N_3 and N_2 resulted in minimum duration (50.66 and 51.66 days respectively) for complete flowering the two being on par. The results are supported by the finding that the number of days taken for 50 per cent flowering was reduced with increasing levels of nitrogen in marigold (Anuradha et al 1988b, Anuradha et al 1990). Chada et al (1999) also obtained earliest flowering in plants treated with 30 kg N/ha. The results are however contradictory to the findings of Arora and Khanna (1986) who reported delayed commencement of flowering in marigold due to application of nitrogen and did not elucidate the causes of such delay. There are divergent views on the effect of nitrogen on flowering. Increased vegetative growth due to its increased levels might help to elaborate more photosynthates and flowering stimulus thus causing early flowering. The increased nitrogen levels stimulating early flowering may be contradictory to the general belief that the plant would normally remain vegetative with delayed flowering due to high nitrogen. But this does not seem true in all cases. Butters (1970) and Vijaykumar and Shanmugavelu (1978) reported early flowering in chrysanthemum with the application of nitrogen with increased levels.

The duration of full flowering was significantly increased with the increased level of phosphorus. Application of phosphorus did not favour early flowering. However these results are not in line with the findings Anuradha et al (1990) and Dahiya et al (1998) who reported that the number of days required for 50 per cent flowering was reduced with the application of phosphorus in marigold. However the reason for such early flowering due to phosphorus was not elucidated by the authors.

In interaction of nitrogen and phosphorus, highest level of nitrogen with no phosphorus (N_3P_0) reduced the number of days to full flowering significantly (50.00 days).

Number of flower heads per plant

The figures given in Table 1 reveal that increase in number of flower heads did not follow the increase in the levels of nitrogen. Highest number of flower heads (28.42) was recorded by plants receiving intermediate level of nitrogen (N_2) while highest dose of nitrogen (N_3) resulted in statistically less number of flower heads (26.02). Increase in flower production due to application of nitrogen over no nitrogen treatment in marigold was reported earlier by various workers (Hameed and Sekar 1999, Yadav and Singh 1997, Dahiya et al 1998, Chandrikapure et al 1999, Halepyati et al 2001). The increase in flower production might be attributed to

improvement in growth of the plant and increase in the number of lateral branches due to nitrogen application. Increase in flower production under nitrogen treatment was mainly due to the regular supply of available nitrogen to the plants (N was applied twice) which improved the vegetative parameters which in turn led to higher production. Similar type of finding was made by Rao et al (1992) in chrysanthemum.

Plants which received highest level of phosphorus (P_2) recorded higher number of flower heads per plant (28.30). The production of flowers was significantly influenced by various treatment combinations of nitrogen and phosphorus. The treatment N_3P_2 was superior over all other treatments (Table 1). The results are in agreement with the findings of Anuradha et al (1990) in marigold.

Size of the flower head

The results recorded on the size of the flower heads in response to the various nutrient treatments and their interactions are furnished in Table 1 which show significant influence of nitrogen and phosphorus and their combinations on the size of the flower head. Among the different levels of nitrogen N_2 and N_1 resulted in largest flower head (5.59 and 5.54 cm respectively). A significant and linear increase in the size of flower head was observed due to increasing levels of phosphorus. The results are in conformity with the findings of Zile Singh

et al (1996) in dahlia. A further evaluation of the data indicated that phosphorus treatments were independent of each other. The interaction of nitrogen and phosphorus was significant on the size of the flower head. The treatment combination N_2P_2 resulted in largest flower head (6.25 cm) and was statistically superior to all other treatments.

Fresh weight of flower heads

The data on fresh weight of flower heads as influenced by the nitrogen and phosphorus presented in Table 1 indicate a significant response of marigold plants to nutrient application. Among the four levels of nitrogen N_2 was observed to be superior over other levels of nitrogen. The effect of phosphorus on the weight of the flower head was linear with increase in phosphorus level. These findings are parallel to the reports of Singh and Sangama (2000). Plants receiving highest levels of nitrogen and phosphorus combined (N_3P_2) produced flowers having maximum fresh weight (75.13 g) and the treatment was superior over all others.

Flower yield

Data presented in Table 1 show that the highest flower yield (11.11 tons/ha) was recorded by plants receiving intermediate level of nitrogen (N_2) while highest dose of nitrogen (N_3) resulted in 10.38 tons/ha yield. Arulmozhiyan and Pappaiah (1989) stated that the increased flower production might be due to increased

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 treatment P_2 recorded significantly highest flower yield (10.80 tons/ha) which was significantly superior to other P levels. The treatment N_3P_2 was superior over all other treatments with respect to flower yield (11.65 tons/ha). Similar type of findings were reported by Jayanthi and Narayana Gowda (1988) and Chezhiyan et al (1986).

Nitrogen content

The data in Table 2 exhibit significant influence of treatments on the nitrogen content of the plants. A linear increase in the content of nitrogen and phosphorus with increase in the levels of nitrogen and phosphorus was observed. There was a progressive increase in the nitrogen content as the levels of nitrogen and phosphorus in combination increased (Table 2).

Phosphorus content

It is clear from Table 2 that treatments showed a significant influence on the content of phosphorus in plants. Nitrogen levels differed statistically but there was not much difference in the contents of phosphorus due to various treatments. An increase in phosphorus content was noted

as the level of phosphorus application was enhanced (Table 2). It might be due to more solubility and mobilization of soil phosphorus affected by the incorporation of nitrogen which resulted in higher uptake and utilization of phosphorus.

Since the absorption of nitrogen was more to promote more growth and production more phosphorus was needed accordingly and the plant might have taken more phosphorus. Anuradha et al (1988a) also reported higher content of nitrogen and phosphorus due to increased application of nitrogen and phosphorus and their combination. The higher uptake of these mineral nutrients and their translocation to different parts might have helped in the production of higher total dry matter and flower yield. Thus it is logical to believe that to build up the required plant status the optimum quantities of nutrients are required to be taken up by the plants and transfer them to different parts to keep the normal growth and development of the crop.

Correlation of yield with other parameters

Yield is the net result of several contributing traits like plant height, number of leaves, number of laterals, number of flowers per plant, weight of flowers and the nutrient content in the plants which have direct bearing on yield and exhibit a positive correlation with yield. The study indicated that the flower yield was significantly and positively correlated with all the above

Table 1. Influence of nitrogen and phosphorus and their interaction on flower characters of marigold var Cracker Jack

Treatment	Days to full flowering	# flower heads/plant	Size of flower head (cm)	Fresh weight of flower head/plant (g)	Flower yield (ton/ha)
Nitrogen					
N ₀	53.66	23.04	5.29	59.97	9.23
N ₁	52.33	26.20	5.54	64.50	9.98
N ₂	51.66	28.42	5.59	71.25	11.11
N ₃	50.66	26.02	5.42	66.56	10.38
SEm	0.49	0.11	0.05	0.13	0.35
CD _{0.05}	1.44	0.34	0.16	0.41	0.10
Phosphorus					
P ₀	51.41	24.22	5.19	61.97	9.60
P ₁	51.83	25.23	5.45	65.09	10.12
P ₂	52.99	28.30	5.74	69.65	10.80
SEm	0.42	0.09	0.04	0.12	0.03
CD _{0.05}	1.25	0.29	0.14	0.36	0.09
Nitrogen x Phosphorus					
N ₀ P ₀	53.00	21.43	5.04	57.53	8.75
N ₀ P ₁	54.00	22.46	5.52	59.33	9.23
N ₀ P ₂	54.00	25.23	5.70	63.06	9.71
N ₁ P ₀	51.66	25.33	5.62	60.96	9.51
N ₁ P ₁	52.00	26.06	5.42	64.73	9.90
N ₁ P ₂	53.33	27.20	5.58	67.80	10.52
N ₂ P ₀	51.00	27.96	5.05	69.70	10.83
N ₂ P ₁	51.33	28.33	5.48	71.43	11.18
N ₂ P ₂	52.66	28.96	6.25	72.63	11.31
N ₃ P ₀	50.00	22.16	5.05	59.70	9.31
N ₃ P ₁	50.00	24.06	5.40	64.86	10.18
N ₃ P ₂	52.00	31.83	5.42	75.13	11.65
SEm	0.85	0.19	0.09	0.24	0.061
CD _{0.05}	2.50	0.58	0.29	0.72	0.181

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Table 2. Nitrogen and phosphorus content marigold var Cracker Jack plant as influenced by nitrogen and phosphorus and their interaction

Treatment	Nitrogen content (%)	Phosphorus content (%)
Nitrogen		
N ₀	1.17	0.22
N ₁	2.40	0.25
N ₂	2.85	0.26
N ₃	3.25	0.28
SEm	0.04	0.006
CD _{0.05}	0.13	0.017
Phosphorus		
P ₀	2.36	0.24
P ₁	2.40	0.25
P ₂	2.49	0.26
SEm	0.04	0.005
CD _{0.05}	0.11	0.015
Nitrogen x Phosphorus		
N ₀ P ₀	1.06	0.21
N ₀ P ₁	1.17	0.23
N ₀ P ₂	1.30	0.22
N ₁ P ₀	2.16	0.24
N ₁ P ₁	2.53	0.25
N ₁ P ₂	2.53	0.26
N ₂ P ₀	2.72	0.25
N ₂ P ₁	2.83	0.27
N ₂ P ₂	3.00	0.27
N ₃ P ₀	3.20	0.28
N ₃ P ₁	3.25	0.29
N ₃ P ₂	3.31	0.28
SEm	0.08	0.01
CD _{0.05}	0.23	0.03

Table 3. Correlation of plant growth parameters with yield of flower yield in marigold var Cracker Jack

Plant height	0.697280
# leaves	0.823564
# primary branches	0.616044
# flower heads	0.946677
Fresh weight of flower heads	0.995802
Nitrogen content	0.683190
Phosphorus content	0.622803

characters but with variation. Number of flowers per plant and fresh weight of flowers exhibited a highly significant and positive correlation with yield (Table 3).

Nitrogen content in the plant also showed greater correlation and influence on the flower yield as compared to phosphorus. Arulmozhan and Pappaiah (1989) and Anuradha et al (1990) also reported similar significant and positive correlation between yield and plant height while in the present investigations the correlation between yield and plant height was moderate. However the significant and positive correlation between yield and number of leaves, number of laterals, number of flowers per plant and weight of flowers observed in the present investigations was in agreement of the results of Arulmozhan and Pappaiah (1989) and Anuradha et al (1990). Therefore a grower should aim at increasing the number of leaves, number of laterals and

the weight of flowers through proper nutrition of the plant to enhance the yield.

Thus it was concluded that under the prevailing agro-climatic conditions of Tirupati a dose of 150-200 kg N plus 200 kg P_2O_5 per ha appears to be an optimum dose for enhancing the yield in marigold var Cracker Jack.

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