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# Assessment of nitrogen and potassium levels for growth, flowering and yield attributes in African marigold

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**Abstract**
The investigation was carried out to assess the nitrogen and potassium levels for growth, flowering and yield attributes of African marigold at Horticulture Section, College of Agriculture, Nagpur, during *kharif*- 2018. The experiment was laid out in Factorial Randomized Block Design with sixteen treatment combinations which was replicated thrice. The treatments comprised two factors main -Nitrogen, 0, 80, 100 and 120 kg $ha^{-1}$ and Potassium, 0, 20, 25 and 30 kg $ha^{-1}$. The results revealed that growth parameters viz. plant height, number of branches $plant^{-1}$ and yield parameters- number of flowers $plant^{-1}$, yield of flowers $plant^{-1}$ and $ha^{-1}$ were significantly maximum. While minimum days were observed in flowering parameters such as, days to first flower bud initiation, days to opening of first flower, days to 50% flowering and days to first harvest in highest level of nitrogen (120 kg N $ha^{-1}$) and potassium (30 kg K $ha^{-1}$). However, interaction effect of nitrogen and potassium levels was found non-significant effect in case of growth and flowering parameters, while significant in yield parameters.

**Keywords:** African marigold, nitrogen, potassium, growth, flowering, yield

## Introduction
African marigold (*Tagetes erecta* L.) is an ornamental herbaceous plant belonging to family Asteraceae commercially grown for its loose flower production. It is popularly known as "Rose of Indies". It is used in various festivals, social and religious functions and hence it has constant demand in market throughout the year. Now a days, these flowers are also used for extraction of carotenoid pigments mainly xanthophyll. Nutrients play major role in growth and development of a plant. Nitrogen and potassium being basic macro nutrients is needed by plant throughout their life cycle. Nitrogen influences vegetative and reproductive growth and flower yield. Whereas potassium plays an important role in activation and stabilization of enzymes, proteins and starch synthesis, turgor maintenance, etc. Hence, present study was conducted for Assessment of nitrogen and potassium levels for growth, flowering and yield attributes in African marigold.

## Material and Methods
An experiment was carried out at Horticulture Section, College of Agriculture, Nagpur, (M.S.), during 2018-19. The experimental plot brought to fine tilth by ploughing, and harrowing. At the time of land preparation, well-rotted FYM @ 10 t $ha^{-1}$ was mixed uniformly in the soil before last harrowing. The field was then laid out with raised beds of the dimension 2.70 m x 3.15 m size and seedling having uniform size were transplanted at spacing of 45 x 30 cm. The soil of the experimental plot was medium black with good drainage. The soil was analyzed for nutritional status. After analysis, the nutritional status was nitrogen 280 kg $ha^{-1}$, phosphorus 16.20 kg $ha^{-1}$ and potassium 294.73 kg $ha^{-1}$ available in soil. Considering the dose of marigold i.e. 100:50:25 NPK Kg $ha^{-1}$, the four levels of nitrogen (0, 80,100,120 kg $ha^{-1}$) and four levels of potassium (0, 20, 25, 30 kg $ha^{-1}$) were decided for experimentation with sixteen treatment combinations and as a statistical tool Factorial Randomized Block Design was applied (Panse and Sukhatme, 1967) [12]. The fertilizers, urea, single super phosphate and muriate of potash were taken as the sources of N, $P_2O_5$ and $K_2O$ respectively. The nitrogen was equally applied in four splits at 20 days interval while potassium was applied in a two splits, half as a basal dose and remaining half at the time of flowering. Phosphorus in the form of single super phosphate was applied as per the recommendation as a basal dose.

## Results and Discussion

The data presented in Tables 1 and 2 revealed that, different nitrogen and potassium levels had significant effect on all growth, flowering, and yield parameters. The interaction effect on all these parameters was found non-significant except number of flowers plant$^{-1}$, yield of flowers plant$^{-1}$ and yield of flowers ha$^{-1}$.

### Growth parameters

Significantly, maximum plant height and number of branches plant$^{-1}$ were observed at highest nitrogen level 120 kg N ha$^{-1}$ while minimum plant height and number of branches plant$^{-1}$ were recorded in control treatment. This might be due to sufficient availability of nitrogen during all the growth stages which lead to formation of amino acids increasing meristematic activities and hence significant effect on vegetative growth was observed. Similar results were obtained by Shinde *et al.* (2014) [16] and Kumar *et al.* (2015) in African marigold and Chopde *et al.* (2015) [4] in annual chrysanthemum.

Highest level of potassium 30 kg K ha$^{-1}$ recorded maximum plant height and number of branches plant$^{-1}$ whereas minimum was recorded in the control. Potassium plays major role in protein and starch synthesis and activates various growth related enzymes which leads in increasing the vegetative growth of plant. The results obtained during the investigation are closely in agreement with the findings of Pal and Ghosh (2010) [10] in African marigold and Amin *et al.* (2015) [2] in gerbera.

The interaction effect on nitrogen and potassium levels for these parameters was found non-significant.

### Flowering parameters

Application of highest level of nitrogen 120 kg ha$^{-1}$ recorded minimum days for first flower bud initiation, days to first flower opening, days to 50% flowering and days to first harvest. However, maximum days were recorded in the control treatment 0 kg N ha$^{-1}$. Minimum days in flowering parameters might be due to better food assimilation and more photosynthates increase carbohydrate level which act as a flowering stimulus causing early flowering. Similar results were reported by Satar *et al*. (2012) [14] Shinde *et al.* (2014) [16] in African marigold, Sharma *et al*. (2015) [15] in gaillardia, Jamil *et al.* (2016) [5] in hippeastrum and Mali *et al.* (2016) [9] in annual chrysanthemum.

Similarly, highest level of potassium 30 kg K ha$^{-1}$ recorded minimum days for first flower bud initiation, days to first flower opening, days to 50% flowering and days to first harvest. Whereas, maximum days were recorded in control treatment. The reduction in days might be due to more availability of potassium which increased the rate of photosynthesis and mobilization of sucrose to the shoots which had positive influence in flower initiation. Similar results were reported by Pal and Ghosh (2010) [10], Kumar and Moon (2014) [7] and Shinde *et al.* (2014) [16] in African marigold and Jamil *et al.* (2016) [5] in hippeastrum.

The interaction effect of nitrogen and potassium levels to all these flowering parameters was found non-significant

**Table 1:** Growth and flowering of African marigold influenced by nitrogen and potassium levels

| Factor - A. Nitrogen (N) | Plant Height (cm) | Number of branches plant$^{-1}$ | Days to first flower bud initiation | Days to first flower opening | Days to 50% flowering | Days to first harvest |
|---|---|---|---|---|---|---|
| $N_1$ – 0 kg ha$^{-1}$ | 89.59 | 17.52 | 47.11 | 12.89 | 66.54 | 77.54 |
| $N_2$ – 80 kg ha$^{-1}$ | 95.75 | 18.62 | 46.09 | 11.21 | 64.03 | 74.54 |
| $N_3$ –100 kg ha$^{-1}$ | 96.11 | 21.69 | 43.64 | 10.82 | 62.60 | 70.93 |
| $N_4$ –120 kg ha$^{-1}$ | 103.51 | 22.02 | 39.43 | 9.65 | 58.10 | 64.49 |
| F test | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |
| SE (m) ± | 2.25 | 0.40 | 1.09 | 0.35 | 1.28 | 1.26 |
| CD at 5% | 6.53 | 1.18 | 3.16 | 1.02 | 3.74 | 3.68 |
| **Factor B. Potassium (K)** | | | | | | |
| $K_1$ – 0 kg ha$^{-1}$ | 94.29 | 18.83 | 46.09 | 12.13 | 64.36 | 73.50 |
| $K_2$ – 20 kg ha$^{-1}$ | 92.10 | 20.02 | 45.67 | 11.08 | 64.22 | 73.24 |
| $K_3$ – 25 kg ha$^{-1}$ | 97.32 | 20.36 | 42.43 | 10.69 | 63.21 | 72.34 |
| $K_4$ – 30 kg ha$^{-1}$ | 101.25 | 20.64 | 42.07 | 10.67 | 59.50 | 68.42 |
| F test | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |
| SE (m) ± | 2.25 | 0.40 | 1.09 | 0.35 | 1.28 | 1.26 |
| CD at 5% | 6.53 | 1.18 | 3.16 | 1.02 | 3.74 | 3.68 |
| **C. Interaction (N x K)** | | | | | | |
| F test | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| SE (m) ± | 4.50 | 0.81 | 2.18 | 0.70 | 2.56 | 2.52 |
| CD at 5% | - | - | - | - | - | - |

**Table 2:** Influence of nitrogen and potassium on yield attributes of African marigold.

| Factor- A Nitrogen (N) | Number of flowers plant$^{-1}$ | Yield of flowers Plant $^{-1}$ (g) | Yield of flowers ha$^{-1}$ (q) |
|---|---|---|---|
| $N_1$ – 0 kg ha$^{-1}$ | 28.16 | 133.89 | 99.14 |
| $N_2$ – 80 kg ha$^{-1}$ | 37.29 | 201.30 | 149.16 |
| $N_3$ – 100 kg ha$^{-1}$ | 39.20 | 264.71 | 196.09 |
| $N_4$ –120 kg ha$^{-1}$ | 41.58 | 330.20 | 244.66 |
| F test | Sig. | Sig. | Sig. |
| SE (m) ± | 1.24 | 6.63 | 4.91 |
| CD at 5% | 3.58 | 19.24 | 14.25 |
| **Factor-B Potassium (K)** | | | |
| $K_1$ – 0 kg ha$^{-1}$ | 33.52 | 201.53 | 149.27 |
| $K_2$ – 20 kg ha$^{-1}$ | 36.46 | 227.63 | 168.65 |
| $K_3$ – 25 kg ha$^{-1}$ | 37.75 | 239.57 | 177.50 |
| $K_4$ – 30 kg ha$^{-1}$ | 38.50 | 261.36 | 193.63 |
| F test | Sig. | Sig. | Sig. |
| SE (m) ± | 1.24 | 6.63 | 4.91 |
| CD at 5% | 3.58 | 19.24 | 14.25 |
| **Factor AxB Interaction (N x K)** | | | |
| $N_1K_1$ | 25.26 | 114.76 | 84.95 |
| $N_1K_2$ | 28.80 | 131.90 | 97.66 |
| $N_1K_3$ | 29.39 | 146.89 | 108.82 |
| $N_1K_4$ | 29.18 | 142.00 | 105.15 |
| $N_2K_1$ | 27.73 | 146.90 | 108.82 |
| $N_2K_2$ | 35.35 | 185.91 | 137.77 |
| $N_2K_3$ | 42..52 | 213.17 | 157.90 |
| $N_2K_4$ | 43.59 | 259.31 | 192.15 |
| $N_3K_1$ | 41.94 | 250.56 | 185.58 |
| $N_3K_2$ | 39.68 | 260.47 | 192.93 |
| $N_3K_3$ | 39.25 | 277.07 | 205.29 |
| $N_3K_4$ | 35.95 | 270.74 | 200.56 |
| $N_4K_1$ | 39.16 | 293.90 | 217.72 |
| $N_4K_2$ | 42.01 | 332.36 | 246.25 |
| $N_4K_3$ | 39.86 | 321.17 | 237.98 |
| $N_4K_4$ | 45.28 | 373.40 | 276.69 |
| F test | Sig. | Sig. | Sig. |
| SE (m) ± | 2.47 | 13.26 | 9.82 |
| CD at 5% | 7.17 | 38.48 | 28.50 |

**Yield parameters**

Significanlty, maximum number of flowers plant$^{-1}$, yield of flowers plant$^{-1}$, and yield of flowers ha$^{-1}$ were observed at highest nitrogen level 120 kg N ha$^{-1}$ while minimum were recorded in the control treatment. This might be due to application of nitrogen which enhances nutrient use efficiency and helps in diversion of more food reserves towards vegetative and reproductive primordial resulting in more number of flowers plant$^{-1}$.The results were in close conformity with the findings of Chopde *et al*. (2015) [4] in annual chrysanthemum, Kumar *et al*. (2015) in African marigold, Ayemi *et al*. (2017) [3] in gerbera and Palekar *et al*. (2018) [11] in African marigold.

Highest level of potassium 30 kg ha$^{-1}$ recorded maximum number of flowers plant$^{-1}$, yield of flowers plant$^{-1}$ and yield of flowers ha$^{-1}$. Whereas, minimum flowers were recorded in control treatment. Potassium is responsible for translocation of food assimilates from source to sink and helps in building stronger transport system and energy gets equally distributed in the whole plant body. The results obtained are in accordance with the findings of Pal and Ghosh (2010) [10], Sanghamitra *et al*. (2015) [13], Ahmed *et al*. (2011) and Kishore (2016) [6] in African marigold.

The interaction effect of nitrogen and potassium levels to yield parameters was found significant. The treatment combination $N_{120}$ $K_{30}$ kg ha$^{-1}$ significantly recorded maximum number of flowers plant$^{-1}$, yield of flowers plant$^{-1}$ and yield of flowers ha$^{-1}$. However, minimum flower yield was observed in control $N_0K_0$ kg ha$^{-1}$. The increase in yield of flowers might be due to application of both nutrients in splits which help in maximum nutritional uptake. Nitrogen and potassium both individually affect the protein content in the plant cell. But their interaction enhances the protein content to more extent. It can be explained as abundance of nitrogen availability in the absence of potassium could not synthesize proteins. But in presence of potassium, enzyme nitrate reductase is activated which catalyzes the formation of proteins. This may also increase disease and pest resistance due which may enhance the yield of flowers. Similar results were obtained by Lasztity *et al.* (1992) [8] in winter cereals. The results obtained during the investigation were similar to the findings of Kishore *et al*. (2016) [6] in African marigold and Teja *et al*. (2017) [17] in annual chrysanthemum.

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