Studies on the Effect of Nitrogen and Potassium on Flowering in Crossandra (*Crossandra infundibuliformis* L.)

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**A B S T R A C T**

An experiment was carried out to study the effect of NK on flowering in crossandra. The experiment consists of sixteen treatment combinations of nitrogen and potassium. The results showed that the maximum number of spikes/plant (39.81), number of florets/spike (576.29), flower yield/plant (582.03 g), weight of 100 flowers (19.19 g), Shelf life (11.95 days) was recorded with 150 kg/ha N along with 60 kg/ha K.

**Keywords**

Crossandra, N effect, K effect, Flowering.

**Materials and Methods**

The experiment was carried out during the *kharif* season of 2013-2014 at Horticultural College and Research Institute, Venkataramannagudem, West Godavari District of Andhra Pradesh. The experiment was laid out in a Randomized Block Design (RBD) with factorial concept replicated thrice. T$_1$ (0 kg nitrogen ha$^{-1}$ + 0 kg potassium ha$^{-1}$), T$_2$ (0 kg nitrogen ha$^{-1}$ + 60 kg potassium ha$^{-1}$), T$_3$ (0 kg nitrogen ha$^{-1}$ + 120 kg potassium ha$^{-1}$), T$_4$ (0 kg nitrogen ha$^{-1}$ + 180 kg potassium ha$^{-1}$), T$_5$ (50 kg nitrogen ha$^{-1}$ +
0 kg potassium ha\(^{-1}\)), T\(_6\) (50 kg nitrogen ha\(^{-1}\) + 60 kg potassium ha\(^{-1}\)), T\(_7\) (50 kg nitrogen ha\(^{-1}\) + 120 kg potassium ha\(^{-1}\)), T\(_8\) (50 kg nitrogen ha\(^{-1}\) + 180 kg potassium ha\(^{-1}\)), T\(_9\) (100 kg nitrogen ha\(^{-1}\) + 0 kg potassium ha\(^{-1}\)), T\(_{10}\) (100 kg nitrogen ha\(^{-1}\) + 60 kg potassium ha\(^{-1}\)), T\(_{11}\) (100 kg nitrogen ha\(^{-1}\) + 120 kg potassium ha\(^{-1}\)), T\(_{12}\) (100 kg nitrogen ha\(^{-1}\) + 180 kg potassium ha\(^{-1}\)), T\(_{13}\) (150 kg nitrogen ha\(^{-1}\) + 0 kg potassium ha\(^{-1}\)), T\(_{14}\) (150 kg nitrogen ha\(^{-1}\) + 0 kg potassium ha\(^{-1}\)), T\(_{15}\) (150 kg nitrogen ha\(^{-1}\) + 120 kg potassium ha\(^{-1}\)), T\(_{16}\) (150 kg nitrogen ha\(^{-1}\) + 180 kg potassium ha\(^{-1}\)). The obtained data was statistically analysed (ANOVA) and presented.

**Results and Discussion**

**Number of spikes/plant**

The data recorded on number of spikes/plant as influenced by nitrogen, potassium & their interactions at 120 and 180 DAT were presented in (Table 1). It was observed that number of spikes/plant was significantly influenced by different levels of nitrogen at 120 DAT and at 180 DAT. Significantly maximum number of spikes/plant (32.11 at 120 DAT and 36.39 at 180 DAT) were recorded with the application of nitrogen @ 150 kg ha\(^{-1}\) (N\(_3\)) followed by 100 kg N ha\(^{-1}\). Maximum number of spikes/plant (20.43 at 120 DAT and 22.09 at 180 DAT) were recorded with the application of potassium @ 60 kg ha\(^{-1}\) (K\(_1\)). Interactions had showed a significant influence on number of spikes/plant at both the stages. At 120 DAT, significantly maximum number of spikes/plant (39.81) were recorded with 150 kg N + 60 kg K ha\(^{-1}\) (N\(_3\)K\(_1\)). At 180 DAT, maximum number of spikes/plant (41.17) were observed with 150 kg N + 60 kg K ha\(^{-1}\) (N\(_3\)K\(_1\)). Number of spikes/plant was found to increase with every increase in the nitrogen level up to 150 kg ha\(^{-1}\). Supply of potassium could bring about an improvement in this parameter up to 60 kg ha\(^{-1}\) only. It is evident that better number of spikes per plant were recorded by nitrogen at 150 kg and potassium at 60 kg individually and also in combination. This combination could have encouraged the plant to put up more dry matter by increased photosynthetic surface or leaf area leading to better outturn of photosynthates which might have stimulated more floral buds and leading to a better number of spikes per plant. Similar results were reported by Dalvi *et al.*, (2008), Khan *et al.*, (2012) and Shaukat *et al.*, (2012) in gladiolus.

**Number of florets/spike**

The data recorded on number of florets/spike as influenced by nitrogen, potassium & their interactions at 120 DAT and 180 DAT were presented in (Table 2). Maximum number of florets/spike (538.47 at 120 DAT, 552.36 at 180 DAT) were recorded with 150 kg ha\(^{-1}\) (N\(_3\)), followed by 100 kg N ha\(^{-1}\). Maximum number of florets/spike (351.39 at 120 DAT and at 180 DAT 378.67) were recorded with potassium application @ 60 kg ha\(^{-1}\) (K\(_1\)) which was followed by 120 kg ha\(^{-1}\) (K\(_2\)). The interactions showed a significant influence on florets/spike was at 120 DAT, significantly maximum number of florets/spike (576.29) were recorded with 150 kg N + 60 kg K ha\(^{-1}\) (N\(_3\)K\(_1\)), followed by 100 kg N + 120 kg K ha\(^{-1}\) (N\(_3\)K\(_2\)). At higher nitrogen levels, more vegetative growth and more accumulation of food reserves are diverted to flower bud differentiation and resulted in more number of florets per spike. Elevated potassium level accelerated many bio-chemical reactions and led to the more number of florets per spike. The mechanism of flower bud initiation and development is closely related to the well flourished vegetative growth. Similar results were reported by Patel *et al.*, (2010), Lehri *et al.*, (2011) and Khan *et al.*, (2012) in gladiolus. The increased number of florets under higher dose of nitrogen may be
attributed to more number of floret bearing branches per plant. Similar increase in flower number with higher fertilizer levels was also noticed by Kumar et al., (2003) and Gnyandev (2006) in China aster, Saud and Ramachandra (2004) and Acharya and Dashera (2004) in marigold.

**Flower yield per plant (g)**

The data recorded on flower yield/plant (g) as influenced by nitrogen, potassium & their interactions at 120 DAT and 180 DAT were presented in (Table 3). maximum flower yield of 480.49 g at 120 DAT and 858.69 g at 180 DAT was recorded with nitrogen @ 150 kg ha⁻¹ (N₃), followed by 100 kg N ha⁻¹. Maximum flower yield (436.46 g at 120 DAT and 816.27 g at 180 DAT) was recorded with potassium application @ 60 kg ha⁻¹ (K₁) which was on par with 120 kg ha⁻¹ (K₂). Interactions had showed a significant influence on flower yield.

**Table.1** Effect of different levels of nitrogen and potassium on number of spikes/plant in crossandra

| Treatment | 120 DAT | 180 DAT |
|-----------|---------|---------|
|           | K₀      | K₆₀     | K₁₂₀    | K₁₈₀    | Mean  | K₀      | K₆₀     | K₁₂₀    | K₁₈₀    | Mean  |
| N₀        | 2.94    | 4.43    | 7.02    | 10.08   | 6.12   | 8.70    | 10.67   | 10.83   | 12.18   | 10.59 |
| N₅₀       | 11.07   | 14.40   | 16.91   | 17.44   | 14.95  | 13.93   | 15.06   | 17.08   | 18.42   | 14.34 |
| N₁₀₀      | 22.82   | 23.09   | 32.76   | 26.79   | 25.58  | 18.35   | 21.33   | 31.98   | 25.05   | 30.94 |
| N₁₅₀      | 27.83   | 39.81   | 28.04   | 29.61   | 32.11  | 27.03   | 41.17   | 27.21   | 29.20   | 36.39 |
| Mean      | 17.39   | 21.29   | 19.64   | 20.43   |        | 17.54   | 22.09   | 19.63   | 22.07   |        |

| Source    | N       | K       | N×K     |
|-----------|---------|---------|---------|
| SE m±     | 0.26    | 0.26    | 0.32    |
| CD at 5%  | 0.76    | 0.76    | 1.52    |

**Table.2** Effect of different levels of nitrogen and potassium on number of florets/spike in crossandra

| Treatment | 120 DAT | 180 DAT |
|-----------|---------|---------|
|           | K₀      | K₆₀     | K₁₂₀    | K₁₈₀    | Mean  | K₀      | K₆₀     | K₁₂₀    | K₁₈₀    | Mean  |
| N₀        | 20.02   | 44.11   | 97.24   | 151.65  | 78.25 | 161.32  | 175.51  | 205.40  | 226.27  | 192.12 |
| N₅₀       | 172.70  | 244.92  | 283.81  | 286.74  | 247.04| 231.47  | 243.00  | 290.30  | 291.85  | 264.15 |
| N₁₀₀      | 362.04  | 418.35  | 562.01  | 473.44  | 423.32| 369.59  | 422.73  | 573.36  | 486.45  | 434.11 |
| N₁₅₀      | 439.45  | 576.29  | 521.82  | 493.74  | 538.47| 457.67  | 581.27  | 544.72  | 510.10  | 552.36 |
| Mean      | 279.19  | 351.39  | 335.58  | 320.92  |        | 333.94  | 378.67  | 374.52  | 355.62  |        |

| Source    | N       | K       | N×K     |
|-----------|---------|---------|---------|
| SE m±     | 0.67    | 0.67    | 1.34    |
| CD at 5%  | 1.95    | 1.95    | 3.90    |

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Table.3 Effect of different levels of nitrogen and potassium on flower yield /plant (g) in crossandra

| Treatment | 120 DAT | | | 180 DAT | | | | 
|---|---|---|---|---|---|---|---|
| | K₀ | K₆₀ | K₁₂₀ | K₁₈₀ | Mean | K₀ | K₆₀ | K₁₂₀ | K₁₈₀ | Mean |
| N₀ | 311.18 | 338.33 | 342.25 | 351.34 | 335.77 | 721.14 | 733.71 | 745.93 | 759.52 | 740.07 |
| N₅₀ | 363.36 | 372.49 | 385.88 | 394.37 | 379.02 | 767.37 | 776.00 | 785.97 | 799.13 | 782.11 |
| N₁₀₀ | 399.09 | 429.11 | 566.44 | 456.69 | 462.83 | 838.83 | 848.45 | 866.80 | 853.98 | 852.05 |
| N₁₅₀ | 432.28 | 582.03 | 451.29 | 456.38 | 480.49 | 850.05 | 876.18 | 856.06 | 852.48 | 858.69 |
| Mean | 335.77 | 436.46 | 430.49 | 414.69 | 480.49 | 794.37 | 816.27 | 813.69 | 808.58 | 858.69 |

Source N K N×K SE m± 0.70 0.70 1.40 0.32 0.32 0.64 CD at 5% 2.04 2.04 4.08

Table.4 Effect of different levels of nitrogen and potassium on weight of 100 flowers (g) in crossandra

| Nitrogen | K₀ | K₆₀ | K₁₂₀ | K₁₈₀ | Mean | | | |
|---|---|---|---|---|---|---|---|---|
| N₀ | 4.70 | 5.43 | 6.79 | 7.31 | 6.06 | | | |
| N₅₀ | 8.34 | 9.21 | 10.86 | 11.43 | 9.96 | | | |
| N₁₀₀ | 12.52 | 13.40 | 14.41 | 15.92 | 14.06 | | | |
| N₁₅₀ | 16.10 | 19.19 | 18.17 | 17.54 | 17.75 | | | |
| Mean | 10.41 | 13.05 | 12.55 | 11.81 | | | | |

Source N K N×K SE m± 0.12 0.12 0.24 CD at 5% 0.36 0.36 0.73

Table.5 Effect of different levels of nitrogen and potassium on shelf life (days) in crossandra

| Nitrogen | K₀ | K₆₀ | K₁₂₀ | K₁₈₀ | Mean | | | |
|---|---|---|---|---|---|---|---|---|
| N₀ | 4.72 | 5.49 | 5.65 | 5.83 | 5.42 | | | |
| N₅₀ | 5.85 | 6.22 | 6.53 | 7.39 | 6.49 | | | |
| N₁₀₀ | 7.47 | 7.77 | 9.35 | 8.27 | 8.21 | | | |
| N₁₅₀ | 8.36 | 11.95 | 8.37 | 9.00 | 9.42 | | | |
| Mean | 6.60 | 7.85 | 7.47 | 7.62 | | | | |

Source N K N×K SE m± 0.27 0.27 0.54 CD at 5% NS NS NS

At 120 DAT, maximum flower yield (582.03 g) was recorded with 150 kg N + 60 kg K ha⁻¹ (N₃K₁) followed by 100 kg N + 120 kg K ha⁻¹ (N₂K₂). The favourable growing environment and climatic factors will contribute for expression of maximum yield potential in the flowers (Betonia, 1996, Praneetha et al., 2002 and Talia et al., 2003).

Weight of 100 flowers (g)

The data recorded on weight of 100 flowers (g) as influenced by nitrogen, potassium & their interactions were presented in (Table 4). The data showed that the weight of 100 flowers increased with increasing levels of nitrogen. The maximum weight of 100 flowers (17.75 g)
was obtained with 150 kg N ha\(^{-1}\) (N\(_3\)) followed by 100 kg N ha\(^{-1}\) (N\(_2\)) with 14.06 g. Among the different levels of potassium, the maximum weight of 100 flowers (13.05 g) was found with 60 kg K ha\(^{-1}\) (K\(_1\)) which was significantly superior to other treatments. The maximum weight of 100 flowers (19.19 g) was recorded with 150 kg N + 60 kg K ha\(^{-1}\) (N\(_3\)K\(_1\)) treatment combination, followed by application of 150 kg N + 120 kg K ha\(^{-1}\) (N\(_3\)K\(_2\)) The role of potassium in plants includes cation transport across membrane, water economy, energy metabolism and enzyme activity as stated by Mengel and Kirby (1980). Potassium increases carbon exchange and enhances carbohydrate movement (Collins and Duke, 1981) and consequently stimulates vegetative growth and decreases the translocation of photosynthates into storage organs. This result may also be due to the role of nitrogen in stimulating vegetative growth as supported by other researcher’s viz., Padaganur et al., (2005) in tuberose, Pandey and Mishra (2005) in marigold.

**Shelf life (days)**

The data recorded on shelf life (days) as influenced by nitrogen, potassium and their interactions were presented in (Table 5). The data indicated that the levels of nitrogen, potassium and their interactions did not have significant effect on the shelf life of florets. However, maximum shelf life (9.42 days) of florets was recorded with 150 kg N ha\(^{-1}\) (N\(_3\)). Among the different levels of potassium, the maximum shelf life (7.85 days) of florets was recorded with 60 kg K ha\(^{-1}\) (K\(_1\)) The maximum shelf life (11.95 days) of florets was recorded with 150 kg N + 60 kg K ha\(^{-1}\) (N\(_3\)K\(_1\)) treatment combinations and the minimum shelf life (4.72 days) was recorded with 0 kg nitrogen and potassium (N\(_0\)K\(_0\)). Similar findings have been obtained by Clark and Burge (1997) and Srinivas (1994) in china aster.

It can be concluded that application of 150 kg/ha N along with 60 kg/ha K would be effective in improving flowering of crossandra.

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How to cite this article:

Gowthami, L., M.B. Nageswararao, K. Umajyothi and Umakrishna, K. 2017. Studies on the Effect of Nitrogen and Potassium on Flowering in Crossandra (*Crossandra Infundibuliformis* L.). *Int.J.Curr.Microbiol.App.Sci.* 6(7): 2537-2541. doi: [https://doi.org/10.20546/ijcmas.2017.607.359](https://doi.org/10.20546/ijcmas.2017.607.359)