

## YIELD AND ECONOMICS OF CROSSANDRA (*CROSSANDRA INFUNDIBULIFORMIS L.*) AS INFLUENCED BY NITROGEN AND POTASSIUM LEVELS

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**Abstract:** The results of the experiment indicated that, the application of nitrogen + potassium @ 150 kg + 60 kg followed by 100 kg + 120 kg significantly improved yield parameters (number of spikes per plant, spike length, number of florets per spike, floret length and flower yield per plant) and B: C ratio.

**Keywords:** B: C ratio, Crossandra, NK levels, Yield

### INTRODUCTION

**C**rossandra (*Crossandra infundibuliformis L.*) is native of India. It is an important group of flowering plants cultivated on a commercial scale and is being grown extensively in South India. The cultivars with orange coloured flowers are generally preferred for commercial cultivation. The plants are quite hardy and can be grown for flowerbeds and /or for loose flowers. Chromosome number is  $2n = 40$ . It is known as Kanakambara in Karnataka and Southern states of India. It does not have fragrant flowers but it is still desired for its distinct colour that has attracted the heart of every human being. It is an evergreen shrub of minor importance. It belongs to the family Acanthaceae. The family contains mainly herbaceous plants but also contains shrubs as well as few small trees. This is a large family of about 200 genera containing 2000 species. It consists of five cultivars, namely, orange, yellow, red, deep orange and bluish flowered forms. It is a sturdy, productive ornamental that should be more popular with indoor gardens. The bright orange coloured flowers are widely used in temple offerings and for making gajras and venis to use as hair adornments.

### MATERIALS AND METHODS

A field experiment entitled 'Yield and economics of Crossandra (*crossandra infundibuliformis L.*) as influenced by nitrogen and potassium levels' was conducted at Horticultural College and Research Institute, Venkataramannagudem, West Godavari district, Andhra Pradesh. The experiment comprising 16 treatment combinations consisted of four levels of nitrogen (0, 50, 100, 150 Kg N/ha) and four levels of potash (0, 60, 120, 180 Kg K/ha) were tried in Factorial Randomized Block Design with three replications.

### RESULTS AND DISCUSSION

#### Number of spikes per plant

Number of spikes per 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) in gladiolus.

#### Spike length (cm)

The length of spike was found to show a significant increase with increase in the dose of nitrogen up to 150 kg  $ha^{-1}$  and potassium up to 60 kg  $ha^{-1}$  only. The combination of nitrogen and potassium was found to be more efficient in bio-mass production with better availability of photosynthates. It is well established that nitrogen is one of the major essential elements, which regulates the cell or tissue functions of the plant being essential part of the nucleic acid, mitochondria and cytoplasmic contents of the cells. Nitrogen has a strong control on vegetative and reproductive stages of the plants. The role of potassium in plants includes cation transport across membrane, water economy, energy metabolism and enzyme activity. Potassium increases carbon exchange and enhances carbohydrate movement. The results are in confirmity with the findings of Patel *et al.* (2010), Lehri *et al.* (2011) in gladiolus.

#### Number of florets per spike

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

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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. 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 Saud and Ramachandra (2004) and Acharya and Dasher (2004) in marigold and Akkannavar (2001) in ageratum.

#### Floret length (cm)

Floret length was relatively better in higher doses of nitrogen and low dose of potassium since it had better nutrition and maintained sufficient reserves by recording a greater amount of dry matter production. The combination of nitrogen and potassium at 150 and 60 kg per hectare was found to produce more florets per spike which were better expanding and sustaining for a prolonged length of time. This nutrient combination showed an increase not only in flower size but also in spike length as evident from the present study. It is clear from these results that a satisfactory level of assimilates and their better partitioning into the reproductive parts could have brought about more floret number on longer spikes and also flowers could express fully in their size thus confirming the advantage of nutrient dose at the above combination. Plants could reach physiologically a better mature position where the strong vegetative frame work could enable them in sharing a better quantum of assimilates into

reproductive organs thus improving their size in terms of floret diameter and length. These results are in concurrence with the findings of Baboo and Singh (2003) in marigold and Kumar *et al.* (2003) in china aster, Singh *et al.* (2008) in Asiatic hybrid lily.

#### Flower yield per plant (g)

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).

#### Benefit - cost ratio

Benefit cost ratio is an important and ultimate factor which decides the optimum level of inputs to be used for maximization of production and returns in any crop. In the present study, the benefit-cost ratio was worked out for different levels of nitrogen and potassium fertilizers. By working out the economics of cultivation of crossandra under field conditions and by imposing these treatment combinations, it was observed that the major portion of cost of cultivation was due to planting material itself and the final cost of cultivation varied based on the treatment combinations comprising of different levels of nitrogen and potassium. The plants provided with nitrogen 150 kg ha<sup>-1</sup> and potassium 60 kg ha<sup>-1</sup> which produced maximum yield, gave maximum net returns per rupee invested thus recording a benefit cost ratio of 4.88 which could be attributed to the efficiency of these treatments in maximizing the returns. Similar findings were also reported by Manjula (2005), Qazi *et al.* (2005) and Nongthombam (2013) in gladiolus.

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

Treatment	120 DAT					180 DAT				
	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean
N <sub>0</sub>	2.94	4.43	7.02	10.08	<b>6.12</b>	8.70	10.67	10.83	12.18	<b>10.59</b>
N <sub>50</sub>	11.07	14.40	16.91	17.44	<b>14.95</b>	13.93	15.06	15.61	17.08	<b>18.42</b>
N <sub>100</sub>	22.82	23.09	32.76	26.79	<b>25.58</b>	18.35	21.33	31.98	25.05	<b>30.94</b>
N <sub>150</sub>	27.83	39.81	28.04	29.61	<b>32.11</b>	27.03	41.17	27.21	29.20	<b>36.39</b>
Mean	<b>17.39</b>	<b>21.29</b>	<b>19.64</b>	<b>20.43</b>		<b>17.54</b>	<b>22.09</b>	<b>19.63</b>	<b>22.07</b>	
Source	N	K	N×K				N	K	N×K	
SE m±	0.26	0.26	0.32				0.49	0.49	0.98	
CD at 5%	0.76	0.76	1.52				1.42	1.42	2.84	

**Table 2.** Effect of different levels of nitrogen and potassium on spike length (cm) in crossandra

Treatment	120 DAT					180 DAT				
	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean
N <sub>0</sub>	3.84	4.35	4.51	4.60	<b>4.32</b>	7.34	7.54	7.61	7.63	<b>7.53</b>
N <sub>50</sub>	4.63	4.74	4.08	4.80	<b>4.74</b>	7.90	8.01	7.96	8.15	<b>7.78</b>
N <sub>100</sub>	4.90	5.16	5.59	5.30	<b>5.23</b>	8.18	8.22	8.49	8.23	<b>8.28</b>
N <sub>150</sub>	5.39	5.81	5.41	5.40	<b>5.51</b>	8.26	8.67	8.34	8.39	<b>8.41</b>
Mean	<b>4.69</b>	<b>5.01</b>	<b>4.89</b>	<b>5.00</b>		<b>7.92</b>	<b>8.11</b>	<b>8.09</b>	<b>8.10</b>	
Source	N	K	N×K				N	K	N×K	

<b>SE m±</b>	0.26	0.26	0.52		0.17	0.17	0.34
<b>CD at 5%</b>	NS	NS	NS		0.51	NS	NS

**Table 3.** Effect of different levels of nitrogen and potassium on number of florets per spike in crossandra

Treatment	120 DAT					180 DAT				
	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean
N <sub>0</sub>	20.02	44.11	97.24	151.65	<b>78.25</b>	161.32	175.51	205.40	226.27	<b>192.12</b>
N <sub>50</sub>	172.70	244.92	283.81	286.74	<b>247.04</b>	231.47	243.00	290.30	291.85	<b>264.15</b>
N <sub>100</sub>	362.04	418.35	562.01	473.44	<b>423.32</b>	369.59	422.73	573.36	486.45	<b>434.11</b>
N <sub>150</sub>	439.45	576.29	521.82	493.74	<b>538.47</b>	457.67	581.27	544.72	510.10	<b>552.36</b>
<b>Mean</b>	<b>279.19</b>	<b>351.39</b>	<b>335.58</b>	<b>320.92</b>		<b>333.94</b>	<b>378.67</b>	<b>374.52</b>	<b>355.62</b>	
<b>Source</b>	<b>N</b>	<b>K</b>	N×K				<b>N</b>	<b>K</b>	N×K	
<b>SE m±</b>	0.67	0.67	1.34				3.65	3.65	7.30	
<b>CD at 5%</b>	1.95	1.95	3.90				10.54	10.54	21.18	

**Table 4.** Effect of different levels of nitrogen and potassium on floret length (cm) in crossandra

Treatment	120 DAT					180 DAT				
	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean
N <sub>0</sub>	3.15	3.16	3.19	3.19	<b>3.17</b>	3.25	3.26	3.28	3.29	<b>3.23</b>
N <sub>50</sub>	3.20	3.21	3.22	3.23	<b>3.21</b>	3.29	3.31	3.30	3.03	<b>3.27</b>
N <sub>100</sub>	3.24	3.29	3.39	3.36	<b>3.32</b>	3.41	3.44	3.48	3.40	<b>3.43</b>
N <sub>150</sub>	3.37	3.40	3.38	3.30	<b>3.38</b>	3.46	3.49	3.36	3.47	<b>3.44</b>
<b>Mean</b>	<b>3.24</b>	<b>3.29</b>	<b>3.26</b>	<b>3.27</b>		<b>3.35</b>	<b>3.37</b>	<b>3.35</b>	<b>3.29</b>	
<b>Source</b>	<b>N</b>	<b>K</b>	N×K				<b>N</b>	<b>K</b>	N×K	
<b>SE m±</b>	0.03	0.03	0.06				0.04	0.04	0.08	
<b>CD at 5%</b>	NS	NS	NS				NS	NS	NS	

**Table 5.** Effect of different levels of nitrogen and potassium on flower yield per plant (g) in crossandra

Treatment	120 DAT					180 DAT				
	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean	K <sub>0</sub>	K <sub>60</sub>	K <sub>120</sub>	K <sub>180</sub>	Mean
N <sub>0</sub>	311.18	338.33	342.25	351.34	<b>335.77</b>	721.14	733.71	745.93	759.52	<b>740.07</b>
N <sub>50</sub>	363.36	372.49	385.88	394.37	<b>379.02</b>	767.37	776.00	785.97	799.13	<b>782.11</b>
N <sub>100</sub>	399.09	429.11	566.44	456.69	<b>462.83</b>	838.83	848.45	866.80	853.98	<b>852.05</b>
N <sub>150</sub>	432.28	582.03	451.29	456.38	<b>480.49</b>	850.05	876.18	856.06	852.48	<b>858.69</b>
<b>Mean</b>	<b>335.77</b>	<b>436.46</b>	<b>430.49</b>	<b>414.69</b>		<b>794.34</b>	<b>816.27</b>	<b>813.69</b>	<b>808.58</b>	
<b>Source</b>	<b>N</b>	<b>K</b>	N×K				<b>N</b>	<b>K</b>	N×K	
<b>SE m±</b>	0.70	0.70	1.40				0.32	0.32	0.64	
<b>CD at 5%</b>	2.04	2.04	4.08				0.93	0.93	1.86	

**Table 6.** Effect of different levels of nitrogen and potassium on economics of crossandra cultivation

Treatment combinations	Additional cost (Rs)	Cost of cultivation (Rs)	Yield/hectare (kg)	Gross returns (Rs)	Net returns (Rs)	Benefit cost ratio
N <sub>0</sub> K <sub>0</sub>	-----	2,12,488.00	2,239.00	8,95,600.00	6,83,112.00	3.21
N <sub>0</sub> K <sub>60</sub>	981.60	2,13,469.60	2326.00	9,30,400.00	7,16,930.40	3.35
N <sub>0</sub> K <sub>120</sub>	1,963.20	2,14,451.20	2347.00	9,38,800.00	7,24,348.80	3.37
N <sub>0</sub> K <sub>180</sub>	2,944.80	2,15,432.80	2413.00	9,65,200.00	7,49,767.20	3.48
N <sub>50</sub> K <sub>0</sub>	284.00	2,12,772.00	2456.00	9,82,400.00	7,69,628.00	3.61
N <sub>50</sub> K <sub>60</sub>	1,265.60	2,13,753.60	2478.00	9,91,200.00	7,77,446.40	3.63
N <sub>50</sub> K <sub>120</sub>	2,247.20	2,14,735.20	2543.00	10,17,200.00	8,02,464.80	3.73
N <sub>50</sub> K <sub>180</sub>	3,228.80	2,15,716.80	2586.00	10,34,400.00	8,18,683.20	3.79
N <sub>100</sub> K <sub>0</sub>	568.00	2,13,056.00	2673.00	10,69,200.00	8,56,144.00	4.01

N <sub>100</sub> K <sub>60</sub>	1,549.60	2,14,037.60	2760.00	11,04,000.00	8,89,962.40	4.15
N <sub>100</sub> K <sub>120</sub>	2,531.20	2,15,019.20	3108.00	12,43,200.00	10,28,180.80	4.78
N <sub>100</sub> K <sub>180</sub>	3,512.80	2,16,000.80	2847.00	11,38,800.00	9,22,799.20	4.27
N <sub>150</sub> K <sub>0</sub>	852.00	2,13,340.00	2782.00	11,12,800.00	8,99,460.00	4.21
N <sub>150</sub> K <sub>60</sub>	1,833.6	2,14,321.60	3152.00	12,60,800.00	10,46,478.40	4.88
N <sub>150</sub> K <sub>120</sub>	2,815.20	2,15,303.20	2826.00	11,30,400.00	9,15,096.80	4.25
N <sub>150</sub> K <sub>180</sub>	3,796.80	2,16,284.80	2827.00	11,30,800.00	9,14,515.20	4.22

Fertilizer cost = Urea – Rs 5 /kg; SSP – Rs 7/ kg; MOP – Rs 16/ kg Selling price of flowers: Rs 400 /Kg

## CONCLUSION

Overall results indicate that the treatment combination of N<sub>150</sub> P<sub>60</sub> kg ha<sup>-1</sup> is the optimum for the cultivation of crossandra under coastal Andhra Pradesh.

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