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EFFECT OF DIFFERENT LEVELS OF NITROGEN AND POTASSIUM ON YIELD ATTRIBUTES OF CROSSANDRA (*CROSSANDRA INFUNDIBULUFORMIS* L.)

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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 *viz*., spike length, spike girth, number of spikes/plant, floret length, floret girth, number of florets/spike, flower yield/plant, weight of 100 flowers.

Key words : Crossandra, NK levels, yield.

Introduction

Habits and customs may differ, but all people have the love for flowers in common. Flowers are the symbol of love, beauty and tranquility, express human sentiments and beautify environment. They are the souls of environment and convey the message of nature. Crossandra (or) Fire Cracker plant (*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. The word crossandra is derived from Greek words 'krossoi' meaning fringe and 'aner' meaning male, thus word crossandra means fringed stamens. It does not have fragrant flowers, but it is still desired for its distinct colour that has attracted the heart of every human being. This flower is also a valuable ornamental pot flower in Sweden, Denmark and Hungary (Ottosen and Christensen, 1986). 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.

Research Methods

A field experiment entitled 'Effect of different levels of nitrogen and potassium on yield attributes of Crossandra (*Crossandra infundibuluformis* L.) conducted at Horticultural College and Resesrch Institute, Venkataramannagudem, West Godavari district, Andhra Pradesh, India. 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.

Research Findings and Discussion

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 nitogen 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 enezyme 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.

Spike girth (cm)

The spike girth was found to show a significant increase with every increase in the dose of nitrogen upto 150 kg and potassium at 60 kg. The combination of nitrogen and potassium was found to be more efficient in bio-mass production with better availability of photosynthates. These results are in conformity with the findings of Khan *et al*. (2012) and Shaukat *et al*. (2012) in gladiolus.

Number of spikes/plant

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) in gladiolus.

Floret length (cm) and floret girth (cm)

Floret length and girth was relatively better in higher doses of nitrogen and low dose of potassium since they 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

Table 1 : Effect of different levels of nitrogen and potassium on spike length (cm) in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	3.84	4.35	4.51	4.60	**4.32**	7.34	7.54	7.61	7.63	**7.53**
N_{50}	4.63	4.74	4.08	4.80	**4.74**	7.90	8.01	7.96	8.15	**7.78**
N_{100}	4.90	5.16	5.59	5.30	**5.23**	8.18	8.22	8.49	8.23	**8.28**
N_{150}	5.39	5.81	5.41	5.40	**5.51**	8.26	8.67	8.34	8.39	**8.41**
Mean	**4.69**	**5.01**	**4.89**	**5.00**		**7.92**	**8.11**	**8.09**	**8.10**	
Source	**N**	**K**		**N×K**			**N**	**K**	**N×K**	
SE m±	0.26	0.26		0.52			0.17	0.17	0.34	
CD at 5%	NS	NS		NS			0.51	NS	NS	

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

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	2.83	2.88	3.05	3.06	**2.95**	3.39	3.47	3.47	3.49	**3.45**
N_{50}	3.06	3.07	3.10	3.11	**3.08**	3.51	3.53	3.53	3.54	**3.52**
N_{100}	3.12	3.13	4.03	3.13	**3.35**	3.55	3.55	4.41	3.59	**3.77**
N_{150}	3.21	4.31	3.28	3.75	**3.63**	3.72	4.65	3.08	4.29	**3.93**
Mean	**3.05**	**3.37**	**3.36**	**3.26**		**3.54**	**3.80**	**3.62**	**3.72**	
Source	**N**	**K**		**N×K**			**N**	**K**	**N×K**	
SE m±	0.15	0.15		0.30			0.16	0.16	0.32	
CD at 5%	NS	NS		0.88			NS	NS	NS	

Table 3 : Effect of different levels of nitrogen and potassium on number of spikes/plant in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	2.94	4.43	7.02	10.08	**6.12**	8.70	10.67	10.83	12.18	**10.59**
N_{50}	11.07	14.40	16.91	17.44	**14.95**	13.93	15.06	15.61	17.08	**18.42**
N_{100}	22.82	23.09	32.76	26.79	**25.58**	18.35	21.33	31.98	25.05	**30.94**
N_{150}	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**				**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 4 : Effect of different levels of nitrogen and potassium on floret length (cm) in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	3.15	3.16	3.19	3.19	**3.17**	3.25	3.26	3.28	3.29	**3.23**
N_{50}	3.20	3.21	3.22	3.23	**3.21**	3.29	3.31	3.30	3.03	**3.27**
N_{100}	3.24	3.29	3.39	3.36	**3.32**	3.41	3.44	3.48	3.40	**3.43**
N_{150}	3.37	3.40	3.38	3.30	**3.38**	3.46	3.49	3.36	3.47	**3.44**
Mean	**3.24**	**3.29**	**3.26**	**3.27**		**3.35**	**3.37**	**3.35**	**3.29**	
Source	**N**	**K**	**N×K**				**N**	**K**	**N×K**	
SE m±	0.03	0.03	0.06				0.04	0.04	0.08	
CD at 5%	NS	NS	NS				NS	NS	NS	

Table 5 : Effect of different levels of nitrogen and potassium on floret girth (cm) in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	1.19	1.53	1.60	1.62	**1.48**	1.35	1.67	1.71	1.74	**1.65**
N_{50}	1.63	1.63	1.55	1.68	**1.62**	1.77	1.78	1.78	1.79	**1.80**
N_{100}	1.70	1.70	1.92	1.73	**1.76**	1.80	1.80	2.07	1.71	**1.88**
N_{150}	1.76	2.06	1.82	1.68	**1.83**	1.84	2.18	1.89	1.95	**1.90**
Mean	**1.57**	**1.73**	**1.72**	**1.67**		**1.69**	**1.86**	**1.84**	**1.82**	
Source	**N**	**K**	**N×K**				**N**	**K**	**N×K**	
SE m±	0.04	0.04	0.08				0.05	0.05	0.10	
CD at 5%	0.12	NS	0.24				0.14	NS	0.29	

Table 6 : Effect of different levels of nitrogen and potassium on number of florets/spike in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	20.02	44.11	97.24	151.65	**78.25**	161.32	175.51	205.40	226.27	**192.12**
N_{50}	172.70	244.92	283.81	286.74	**247.04**	231.47	243.00	290.30	291.85	**264.15**
N_{100}	362.04	418.35	562.01	473.44	**423.32**	369.59	422.73	573.36	486.45	**434.11**
N_{150}	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**				**N**	**K**	**N×K**	
SE m±	0.67	0.67	1.34				3.65	3.65	7.30	
CD at 5%	1.95	1.95	3.90				10.54	10.54	21.18	

Table 7 : Effect of different levels of nitrogen and potassium on flower yield /plant (g) in crossandra.

Treatment	120 DAT					180 DAT				
	K_0	K_{60}	K_{120}	K_{180}	Mean	K_0	K_{60}	K_{120}	K_{180}	Mean
N_0	311.18	338.33	342.25	351.34	**335.77**	721.14	733.71	745.93	759.52	**740.07**
N_{50}	363.36	372.49	385.88	394.37	**379.02**	767.37	776.00	785.97	799.13	**782.11**
N_{100}	399.09	429.11	566.44	456.69	**462.83**	838.83	848.45	866.80	853.98	**852.05**
N_{150}	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**		**794.34**	**816.27**	**813.69**	**808.58**	
Source	**N**	**K**	**N×K**				**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				0.93	0.93	1.86	

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.

Number of florets/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 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 Dashera (2004) in marigold and Akkannavar (2001) in ageratum.

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).

Conclusion

Overall results indicate that the treatment combination of N_{150} P_{60} kg ha^{-1} is the optimum for the cultivation of crossandra under coastal Andhra Pradesh.

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