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Efficacy of nutritional management on flowering of *Anthurium andraeanum* cv. Tropical

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Abstract
An experiment was carried out to study the impact of nutritional management on flowering of anthurium under agroshadenet of BTCC LAB, Baramunda, Dept. of Floriculture & Landscaping, OUAT Bhubaneswar with objectives to study the effect of nutrients on flowering of Anthurium cv. Tropical. The potting mixture comprised of substrates like charcoal, coconut husk, mango bark, coconut chops and bricks in equal proportion and pots were placed under agro shadenet structure having 50% shade. The fifteen treatments comprised of substrate application of RDF- Urea: SSP: MOP@ 7.2:4.6:3.0g/plant alone and in combination with Ca as Calcium carbonate (1.6g/plant), Mg as Magnesium sulphate (1.5g/plant), foliar application of Sulphur as Wettable Sulphur (1.5mg/l) and MS Micro (10ml/l). Urea, SSP and MOP were applied to the plants. The experiment was laid out in Completely Randomized Design and replicated thrice.
The result of the investigation revealed that substrate application of RDF Urea:SSP: MOP @ 7.2:4.6:3.0 g/plant, Ca as Calcium carbonate (1.6g/plant), Mg as Magnesium sulphate (1.5g/plant) significantly enhanced the floral characters like stalk length (12.83 cm), number of flower per plant /month (2.15), spathe length (8.7cm), spathe breadth (7.16cm), spadix length (4.3cm) and spadix breadth (1.5cm) as compared to other treatments.

Keywords: agro shade net, substrate application, floral characters

Introduction
Anthuriums are tropical plants grown for their showy cut flowers and attractive foliage. Anthurium has gained the importance as major cut flower of the modern world. Anthurium growing is a potential source of commercial farming and it makes best use of ready market for cut flowers with high returns both for its cut flower and whole plant. In India, the anthurium cut flower industry is still in its infancy. At present anthuriums are mostly grown in some small gardens and nurseries. However, some progressive farmers started growing anthurium under protected condition around Bangalore, Belgaum, Goa, Sirsi etc. The important states cultivating anthuriums are Assam, Kerala, Tamilnadu (Salem) and Karnataka (Coorg), where the favourable climate exists.

In comparison to the last three years Odisha has emerged as the top states in terms of flower production and occupied third position in the country from eighth position. Though area under floriculture has not increased but productivity has increased both in cut and loose flowers. It is a great opportunity for a state like Odisha to promote flower production especially cut flower production.in coming years. Malkangiri, ports of Koraput, Rayagada in north eatern ghats, Ganjam, Kandhamal, Kendrapada, Jagatsinghpur, Khurda, Puri, Nayagarh are suitable for anthurium cultivation in Odisha (Beura *et al.*, 2017) [1] Even though grown by many planters, there is very less scientific information on the use of foliar application of nutrients. Standardization of nutrients is most important to obtain higher yield and quality of the flower. The present investigation entitled, "Nutritional Management in Anthurium (*Anthurium andraeanum*) var. Tropical" was taken under greenhouse to find out the optimum dose of nutrients for the plant with the objective to study the effect of nutrients on flowering of anthurium.

Materials and Methods
To carry out the experiment Clay pots of 30 cm diameter and 25cm height were used for planting anthurium plants. Pots were provided with holes in the base for proper drainage and

aeration. The drainage holes of the pot were covered with broken crocks for proper drainage. The anthurium plants were planted in potting mixture comprising of charcoal, coconut husk pieces, coconut chops, mango bark and broken brick pieces in equal proportion, coarse sand and broken bricks. The coconut husks were collected from mature coconuts, cut into 2"X 2" pieces (approx.) and were washed thoroughly before being used as potting mixture. The plants were then planted in middle of the plant and watered. Anthurium plants were kept in a shade net house having 50% shade. Fifty percent shade was provided by green color shade net. The pots were placed in a shady place.

Treatment details

The experiment was laid out with fifteen treatments. The detailed information regarding treatments are as follow

Sl. No.	Fertilizers	Symbol
1	RDF, Urea: SSP: MOP @ 7.2:4.6:3.0g/plant	T_1
2	RDF + Calcium carbonate (1.6g)/plant	T_2
3	RDF + Magnesium sulphate (1.5g/plant)	T_3
4	RDF + Wettable Sulphur (1.5mg/l)	T_4
5	RDF + Calcium carbonate (1.6g)/plant + Magnesium sulphate (1.5g/plant)	T_5
6	RDF + Calcium carbonate (1.6g)/plant + Wettable Sulphur (1.5mg/l)	T_6
7	RDF + Magnesium sulphate (1.5g/plant) + Wetable Sulphur (1.5mg/l)	T_7
8	RDF + Magnesium sulphate (1.5g/plant) + Calcium carbonate (1.6g)/plant + Wettable Sulphur (1.5mg/l)	T_8
9	RDF + Calcium carbonate (1.6g)/plant + MS Micro (10 ml/litre)	T_9
10	RDF + Magnesium sulphate (1.5g/plant) + MS Micro (10 ml/litre)	T_{10}
11	RDF + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	T_{11}
12	RDF + Calcium carbonate (1.6g)/plant + Magnesium sulphate (1.5g/plant) + MS Micro (10 ml/litre)	T_{12}
13	RDF + Calcium carbonate (1.6g)/plant + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	T_{13}
14	RDF + Magnesium sulphate (1.5g/plant) + Wettable Sulphur (1.5mg/l MS Micro (10 ml/litre)	T_{14}
15	RDF + Calcium carbonate (1.6g)/plant + Magnesium sulphate (1.5g/plant) + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	T_{15}

Urea was given twice a month i.e 15th and 30th day of the month through direct substrate application. Calcium Carbonate and Magnesium Sulphate were given oncce a month through substrate application.

Micronutrient spray was done with a clean hand pump sprayer.

Results and Discussion

Table: Effect of nutrients on flowering characters of Anthurium cv. Tropical

Treatment		Flowering characters		
		Stalk Length (cm)	Days to flower opening	Number of flowers
T_1	RDF, Urea:SSP:MOP @ 7.2:4.6:3.0 g/ plant	11.39	154.33	2.0
T_2	RDF + $CaCO_3$ (1.6g)/plant	12.33	123.16	0.5
T_3	RDF + $MgSO_4$ (1.5g/plant)	11.82	133.45	1.23
T_4	RDF + Wettable Sulphur (1.5mg/l)	11.53	143.56	1.12
T_5	RDF + $CaCO_3$ (1.6g)/plant + $MgSO_4$(1.5g/plant)	12.83	145.65	2.15
T_6	RDF + $CaCO_3$ (1.6g)/plant + Wettable Sulphur (1.5mg/l)	12.23	167.43	1.30
T_7	RDF +$MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l)	12.44	170.25	1.12
T_8	RDF + $MgSO_4$ (1.5g/plant) + $CaCO_3$ (1.6g)/plant + Wettble Sulphur (1.5mg/l)	12.67	171.36	2.02
T_9	RDF + $CaCO_3$ (1.6g)/plant + MS Micro (10 ml/litre)	12.46	168.53	0.71
T_{10}	RDF + $MgSO_4$ (1.5g/plant) + MS Micro (10 ml/litre)	12.06	146.73	1.00
T_{11}	RDF + Wettable Sulfur (1.5mg/l) + MS Micro (10 ml/litre)	12.76	150.29	1.42
T_{12}	RDF + $CaCO_3$ (1.6g)/plant + $MgSO_4$ (1.5g/plant) + MS Micro (10 ml/litre)	12.21	120.43	1.23
T_{13}	RDF + $CaCO_3$(1.6g)/plant + Wettable Sulphur (1.5mg/l) +MS Micro (10 ml/litre)	12.42	138.50	1.15
T_{14}	RDF + $MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	12.75	140.00	1.65
T_{15}	RDF + $CaCO_3$ (1.6g)/plant + $MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	13.46	160.33	1.31
	SEm(±)	0.11	0.13	0.1
	C.D. 5%	0.32	0.39	0.28

Effect of nutrients on floral characters of Anthurium cv. Tropical

Treatment		Floral characters					
		Spathe length (cm)	Spathe breadth (cm)	Spathe colour	Spadix length (cm)	Spadix breadth (cm)	Spadix colour
T_1	RDF (Urea:SSP:MOP) (7.2:4.6:3.0g/plant)	5.43	5.75	Light Red	2.84	1	Light Yellow
T_2	RDF + $CaCO_3$ (1.6g)/plant	6.8	6.46	Red	3.23	1.3	Yellowish Green
T_3	RDF + $MgSO_4$ (1.5g/plant)	7.10	6.86	Light Red	3.46	1.4	Green Yellow
T_4	RDF + Wettable Sulphur (1.5mg/l)	7.76	6.43	Red	3.60	1.5	Yelow
T_5	RDF + $CaCO_3$ (1.6g)/plant + $MgSO_4$ (1.5g/plant)	8.72	7.16	Deep Red	4.32	1.5	Yellow
T_6	RDF + $CaCO_3$ (1.6g)/plant + Wettable Sulphur (1.5mg/l)	7.70	6.56	Red	4.06	1.2	Light Yellow
T_7	RDF + $MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l)	7.23	6.53	Red	3.70	1.3	Light Yellow
T_8	RDF + $MgSO_4$ (1.5g/plant) + $CaSO_4$ (1.6g)/pot + Wettable Sulphur (1.5mg/l)	7.35	6.72	Red	4.14	1.1	Yellow
T_9	RDF + $CaCO_3$ (1.6g)/plant + MS Micro (10 ml/litre)	8.32	6.96	Red	3.90	1.3	Yellow
T_{10}	RDF + $MgSO_4$ (1.5g/plant) + MS Micro10 ml/litre)	7.66	6.53	Red	3.50	1.2	Yellow
T_{11}	RDF + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	7.23	6.93	Red	4.14	1	Yellow
T_{12}	RDF + $CaCO_3$ (1.6g)/plant + MgSO4 (1.5g/plant) + MS Micro (10 ml/litre)	8.03	6.21	Red	3.54	1.1	Yellow
T_{13}	RDF + $CaCO_3$ (1.6g)/plant + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	7.06	5.96	Red	4.13	1.2	Yellow
T_{14}	RDF + $MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	7.43	6.96	Red	3.73	1.32	Yellow
T_{15}	RDF + $CaCO_3$ (1.6g)/plant + $MgSO_4$ (1.5g/plant) + Wettable Sulphur (1.5mg/l) + MS Micro (10 ml/litre)	8.26	7	Red	4.10	1.07	Yellow
	SEm (±)	0.12	0.11		0.53	0.06	
	C.D. 5%	0.35	0.31		1.5	0.17	

Stalk length (12.83cm) was found maximum in the treatment T_5 (RDF- Urea: SSP: MOP @ 7.2:4.6:3.0 g/plant, $CaCO_3$ @ 1.6 g/plant, $MgSO_4$ 1.5 g/plant). This finding concurred with those of Higaki & Poole (1978), who observed that nutrient application did not affect the length of the anthurium floral stem in the first year of growth.

Number of flowers (2.15) was found maximum in treatment T_5 (RDF, Ca and Magnesium (RDF- Urea: SSP: MOP @ 7.2:4.6:3.0 g/plant, $CaCO_3$ @ 1.6 g/plant, $MgSO_4$ 1.5 g/plant). Generally 10 to 12 numbers of flower are produced per year in an anthurium plant. In this experiment the treatment T_5 (RDF- Urea: SSP: MOP @ 7.2:4.6:3.0 g/plant, $CaCO_3$ @ 1.6 g/plant, $MgSO_4$ 1.5 g/plant) produced 2.15 number of flowers/plant and 0.5 number of flowers/plant in control. This characteristic may have played a role in the response to fertilization not having been immediate, especially since it was the first year of cultivation, when the plant had still not expressed all its production potential.

Spathe length (8.7cm) was found maximum in treatment T_5 (RDF + Ca + Magnesium). The low K and Mg concentrations can be attributed to the antagonistic effect between N and K or between N and Mg (Marschner, 1995; Poole and Sheehan, 1974).

Spathe breadth (7.16cm) was recorded best in the plants treated with RDF - Urea: SSP: MOP @ 7.2:4.6:3.0 g/plant, $CaCO_3$ @ 1.6 g/plant, $MgSO_4$ 1.5 g/plant. Floral characters depend upon supply of nutrients, growth and climate. Higher dose of nutrients resulted in better quality of flowers and good spathe color and spathe area. Due to increased supply of nutrients healthy and vigorous plants are produced Jawaharlal *et al.* (2001) [6] also recorded same findings.

Conclusion

From the experiment conducted it was found that application of macro and micronutrients revealed significant result on flowering of Anthurium cv. Tropical. From the data recorded, it has was concluded that the plants treated with RDF (Urea: SSP: MOP), Calcium carbonate and Magnesium sulphate i.e. treatment (T_5) showed maximum stalk length (12.83 cm), number of flowers (5.6), spathe length (8.7cm), spathe breadth (7.16cm), spadix length (4.3cm) and spadix breadth (1.5cm), whereas earliness in flower opening (120.43days) was found to be in the treatment T_{12} (RDF- Urea: SSP: MOP @ 7.2:4.6:3.0 g/plant, $CaCO_3$ @ 1.6 g/plant, $MgSO_4$ 1.5 g/plant and MS Micro 10 ml/litre).

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