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Effect of foliar application of primary nutrients and their frequencies on production and economics of *Anthurium* Var. Xavia

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Abstract
An investigation was carried out under protected conditions at the Polyhouse Complex, Department of Horticulture (Veg. and Flori.), Bihar Agricultural University, Sabour, Bhagalpur, and Bihar during the year 2016-2017. The study was conducted to find out effect of primary nutrients levels and their frequencies on growth and economics of *Anthurium* cultivation. The experiment was laid out in Completely Randomized Design with Factorial Concept and replicated thrice. Total 10 treatment combinations tried, comprising five levels of water soluble fertilizer (1 g/l, 2 g/l,3 g/l, 4 g/l and 5 g/l) and two frequencies of spray (once a week and twice a week). Data recorded on different growth, flowering and economics. Actual cost incurred during cultivation was worked out based on fixed cost, operational cost and cost of cultivation. The Gross total income was also determined. Further, on the basis of this information the benefit cost ratio was achieved. The economics involved in *Anthurium* production revealed that the treatment combination D_4F_2 (spray of 19:19:19 NPK at 4 g/l twice in a week) resulted in the maximum benefit cost ratio (1:1.09).

Keywords: *Anthurium*, nutrients, economics, benefit cost ratio and cost of cultivation

Introduction
Floriculture is fast emerging industry in the world and is a lucrative profession with higher potential for returns than most of the field and other horticultural crops. The demand for flowers both in India and International markets is increasing at a faster rate owing to the liberalization of economy and globalization of trade. India is the leading country in the world in floriculture terms of area, 278000 ha with producing 1656000 MT of loose flowers and 528000 MT cut flowers in 2015-16 (Anonymous, 2017). Indian flowers are now being recognized at global level and the export of total floricultural products was Rs. 548.74 crores during the year 2016-17 (APEDA). During 2015-16 the area under floriculture production in India was 249 thousand hectares with a production of 1659 thousand tonnes loose flowers and 484 thousand tonnes cut flowers (APEDA). Among all the flowers *anthurium* occupies a predominant position with respect to cut flowers. It important ornamental evergreen slow-growing herbaceous perennial flower crops which taxonomically belongs to family Araceae (Sheffer and Croat, 1983) [1]. This evergreen plant is native to Columbia, Peru, Central and South America. It requires shady, humid conditions as found in tropical forests hence suited to Indian climate. It is popular for its colourful long lasting unique flowers or for the attractive foliage. It is a stem less and tropical plant which requires shadesup to 75% for its cultivation. Unlike other commercial flowers *anthurium* bears bright and showy spathe (modified leaf) and spadix (an inflorescence). It has got long vase life of about 13-15 days, so widely used in flower arrangements, bouquet preparation and indoor decoration. Meanwhile, *anthurium* as a potted plant has a colossal demand for interiorscaping. Foliar application of nutrients is easy and quick approach to provide nutrient requirement of *anthurium*. Keeping in view the limited studies and less available information regarding effect of foliar spray of primary nutrients, the present investigation was carried out.

Materials and Methods
The present investigation was conducted at the Polyhouse Complex, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur during 2016-17 with the objective to find out economically best treatment combination of

nutrients and their frequencies. Nine months old uniformly developed suckers of *Anthurium* Var. 'Xavia' having good demand for cut flowers were used for the present experiment and planted in 30 cm (12") pots. Plants maintained in 75% net house and 60-65 per cent relative humidity. The maximum and minimum temperature during cropping period was recorded to be 33.2 °C and 25.1 °C, respectively. Ten treatment combination involving five different levels of primary nutrients NPK (19:19:19) *viz*. D_1-1 g/l, D_2-2 g/l, D_3-3 g/l, D_4-4 g/l and D_5-5 g/l) and two frequency of spray *viz*. F_1-once a week and F_2- twice a week, thus the total 10 treatment combination was represented as D_1F_1-NPK (19:19:19) @ 1gm/l once a week, D_1F_2-NPK (19:19:19) @1gm/l twice a week, D_2F_1-NPK (19:19:19) @ 2gm/l once a week, D_2F_2-NPK (19:19:19) @ 2gm/l twice a week,D_3F_1- NPK (19:19:19) @ 3gm/l once a week, D_3F_2-NPK (19:19:19) @ 3gm/l twice a week, D_4F_1- NPK (19:19:19) @ 4gm/l once a week, D_4F_2-NPK (19:19:19) @ 4gm/l twice a week, D_5F_1-NPK (19:19:19) @ 5gm/l once a week, D_5F_2-NPK (19:19:19) @ 5gm/l twice a week. Experiment was laid out in Factorial Completely Randomized Design and all treatment combinations replicated three times. The water soluble fertilizers of calcium nitrate (0.5g/l) plus magnesium sulphate (0.5g/l) at 15 days interval were used during the course of investigation for all the treatment. The micronutrient mixture was also applied once in fortnight interval @ 0.5g per litre. The economics was worked out taking both variable and fixed costs into account. The benefit cost ratio was determined on the basis of cost of cultivation and total gross income. The main motto of this investigation was to determine the optimum/economical level of primary nutrients and their frequency which could render highest benefit cost ratio to the growers on the market point of view.

Result and Discussion

Vegetative and flowering parameters

Data presented in Table-1 & 2 revealed that the growth and flowering attributes *viz*., plant height (cm), leaf area, period of inflorescence emergence to spathe unfurling (days), flower longevity on plant were significantly influenced by the different levels of nutrients and their frequencies except spadix diameter of *Anthurium*. Spadix diameter not affected by different nutrient levels as well as frequencies of spray. Among different levels of nutrients, the maximum plant height (40.45 cm) was recorded in treatment D_4 (NPK (19:19:19) @ 4 gm/l), which was at par with treatments D_5 (40.02 cm) and D_3 (39.24 cm). The maximum leaf area recorded under treatment D_5 (337.33 cm^2) which was at par with D_4 and D_3 treatments. It reveals that increasing dose of nutrients increase the height and leaf area of the plants (Jana *et al*., 1974) [2]. Particularly, nitrogen is attributed to its effect on vegetative characters because it is major constituent of chlorophyll and involved in major physiological process like photosynthesis (Baboo and Singh, 2006) [3]. For the plant height the results are in close conformity with the findings of Srinivasa and Reddy (2005) [4] and Tatte *et al*. (2018) [5] in *Anthurium*. The minimum days to inflorescence to spathe unfurling (30.77 days) was recorded in treatment D_5 which was at par with D_4 treatment. The early spathe unfurling flowering was probably due to increased availability of nutrients during the juvenile phase, which increased photosynthesis and respiration with enhanced carbon-di-oxide fixation, there by induced early flowering. The present results are in accordance with the findings of Jawaharlal *et al*. (2001) [6], Srinivasa and Reddy (2005) [4] and Gurjar *et al*. (2012) [7] in *Anthurium*. Flower longevity on plant was observed maximum (41.70 days) in treatment D_5 which was at par with treatment D_4 (40.83 days). The maximum flower longevity on plant might be due to effect of higher dose of potash. Similar results were observed in *Anthurium andreanum* cv. 'Hawaiin Red' by Valsalakumari *et al*. (2001) [8]. In case of frequencies of the foliar spray, maximum plant height (39.85 cm), leaf area (329.71 cm^2), spadix diameter, flower longevity on plant ((40.95 days)) and minimum days to inflorescence emergence to spathe unfurling (31.53) were recorded in F_2 i.e. spray twice a week. It might be due to frequent application of nutrients and readily supply of nitrogen which is responsible for more transport of metabolites for plant growth (Marshner, 1983) [9].These results are in line with Paull *et al*. (1992) [10] and Gurjar *et al*. (2012) [7] in *Anthurium*.

A perusal of the data (Table-1 & 2) revealed that the interaction (D x F) between nutrient levels and frequency of the spray per week was found to be non-significant in terms of plant height, leaf area, inflorescence to spathe unfurling and spadix diameter. Flower longevity on plant was significantly affected by nutrient levels and frequencies. Maximum flower longevity on plant was recorded in D_4F_2 (42.87 days) which was at par with D_5F_2 and D_3F_2. The higher flower longevity might be due to optimum availability of nutrients and higher level of potash. Potash enhances the synthesis, metabolism and translocation of carbohydrate, synthesis of protein with rapid cell division and differentiation, which results in better flowers longevity. (Haque *et al*., 2001) [11].

Economics of cultivation

The economics involved in *Anthurium* production are presented in Table-2. In the present investigation, economics of *Anthurium* was worked out by fixed cost, operational cost, cost of cultivation and gross income from the produce. After working out the net profit from expenses incurred and receipts realized, it was found that the treatment combination D_4F_2 (spray of 19:19:19 NPK at 4 g/l twice in a week) resulted in the maximum benefit cost ratio (1:1.09) followed by D_5F_2 treatment combination (spray of 19:19:19 NPK at 5 g/l twice in a week). However, maximum gross returns (Rs. 349.60/pot) obtained from treatment combination D_5F_2 (spray of 19:19:19 NPK at 5 g/l twice in a week) from evident of Table-2. The higher benefit cost ratio in D_4F_2 treatment combination, because of the production of "A" grade quality plants and maximum net profit per pot compared to all the treatment combinations.

Table 1: Effect of foliar spray of primary nutrients and their frequencies on vegetative growth and flowering of *Anthurium* (*Anthurium andreanum* L.) var. Xavia

Treatments	Plant height (cm)	Leaf area (cm^2)	Days to inflorescence emergence to spathe unfurling	Spadix diameter (cm)	Flower longevity on plant (days)
Levels of nutrients					
D_1- NPK (19:19:19) @ 1gm/l	37.31	303.56	33.77	3.24	38.67
D_2- NPK (19:19:19) @ 2 gm/l	38.13	312.35	33.13	3.30	39.00
D_3- NPK (19:19:19) @ 3 gm/l	39.24	326.97	32.27	3.40	40.40

D_4-NPK (19:19:19) @ 4 gm/l	40.45	331.96	31.43	3.46	41.20
D_5-NPK (19:19:19) @ 5 gm/l	40.02	337.33	30.77	3.47	41.33
C.D. at 5%	1.90	15.18	1.30	NS	1.15
Frequencies of spray					
F_1- Spray once a week	38.22	315.17	33.01	3.32	39.29
F_2- Spray twice a week	39.85	329.71	31.53	3.43	40.95
C.D. at 5%	1.20	9.60	0.82	NS	0.73
Interaction (D x F)					
D_1F_1	36.69	302.44	34.47	3.23	38.53
D_1F_2	37.93	304.69	33.07	3.25	38.80
D_2F_1	37.20	305.18	34.00	3.29	38.87
D_2F_2	39.06	319.52	32.27	3.32	39.13
D_3F_1	38.82	316.42	32.80	3.31	39.00
D_3F_2	39.67	337.53	31.73	3.49	41.80
D_4F_1	39.09	321.26	31.93	3.36	39.53
D_4F_2	41.80	342.67	30.93	3.55	42.87
D_5F_1	39.27	330.53	31.87	3.38	40.53
D_5F_2	40.76	344.12	29.67	3.55	42.13
C.D. at 5%	NS	NS	NS	NS	1.62

Table 2: Economics of different primary nutrients levels and their frequency on economics of *anthurium* var. Xavia

Treatments	General cost of 10 months	Cost of NPK (19:19:19) per pot (Rs.)	Total cost/pot (Rs.)	Flower Yield/plant	Income (Rs.)		Gross Income (Rs.)	Net Return (Rs.)	B: C Ratio
					Flowers	Plant with pot			
D_1F_1	146.98	2.40	149.38	2.40	28.80	200	228.80	79.42	0.53
D_1F_2	146.98	4.80	151.78	2.82	33.80	200	233.80	82.02	0.54
D_2F_1	146.98	4.80	151.78	2.60	31.20	200	231.20	79.42	0.52
D_2F_2	146.98	9.60	156.58	3.03	36.40	200	236.40	79.82	0.51
D_3F_1	146.98	7.20	154.18	2.88	34.60	200	234.60	80.42	0.52
D_3F_2	146.98	14.40	161.38	3.13	37.60	250	287.60	126.22	0.78
D_4F_1	146.98	9.60	156.58	3.07	36.80	250	286.80	130.22	0.83
D_4F_2	146.98	19.20	166.18	4.00	48.00	300	348.00	181.82	1.09
D_5F_1	146.98	15.00	161.98	3.13	37.60	250	287.60	125.62	0.78
D_5F_2	146.98	24.00	170.98	4.13	49.60	300	349.60	178.62	1.04
Flower sale @ Rs. 12 per flower stick									
Whole plant with pot sale @ A grade plants- Rs. 300, B grade plants- Rs. 250, C grade plants- Rs. 200 per pot plant									

Conclusion

In this study, among all treatments, D_5F_2 (NPK 19:19:19 @ 5gm/l twice a week) found to be best in terms of vegetative growth and flowering of *Anthurium* var. Xavia whereas maximum plant height was noticed in D_4F_2 treatment. The maximum net return and maximum benefit cost ratio was noted in D_4F_2 (NPK 19:19:19 @ 4gm/l twice a week). Therefore, it can be concluded from this study that keeping benefit cost ratio in view, treatment combination D_4F_2 (NPK 19:19:19 @ 4gm/l twice a week) is better for cultivation of *Anthurium* var. Xavia under protected cultivation.

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