Effect of Foliar Spray of Primary Nutrients and their Frequency on Anthurium (*Anthurium andreanum* L.) var. Xavia under Protected Conditions

ABSTRACT

The experiment was conducted under protected conditions at the Polyhouse Complex, Department of Horticulture (Veg. and Flori.), Bihar Agricultural University, Sabour, Bhagalpur, Bihar during the year 2016-2017. The experiment was laid out in Factorial Completely Randomized Design with three replication and 10 treatment combinations, 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). Plants were maintained in net house conditions (75% shade). The result indicated that among all treatment combinations, D_5F_2 (NPK 19:19:19 @ 5 g~~m~~/l twice a week) found to be best in terms of vegetative growth, flowering and productivity of anthurium var. Xavia as it recorded maximum values for all the characters. The treatment combination D_5F_2 (NPK 19:19:19 @ 5 g~~m~~/l twice a week) recorded maximum length and breadth of leaf (26.02 cm and 15.48 cm, respectively), plant spread east to west and north to south (62.67 cm and 62.37 cm, respectively), petiole length (36.76 cm), flower stalk length (29.17 cm), spathe length and breadth (9.61 cm and 8.30 cm, respectively) and higher yield of flowers per plant (4.13). It required minimum days (90.93 days) for first flower opening. Hence considering the positive effects on growth, flowering, yield and quality, the treatment combination D_5F_2 (NPK 19:19:19 @ 5 g~~m~~/l twice a week) can be considered for adopting at the field level to get better qualitative and quantitative yield.

Key words: Anthurium, protected, water soluble, vegetative, flowering, primary nutrient

1. INTRODUCTION

Anthurium (*Anthurium andreanum*) is one of the most important ornamental evergreen slow-growing herbaceous perennial flower crops which are grown in several locations across the world. Taxonomically anthurium belongs to family Araceae. 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 flowers. Lately, it has gained identity as major cut flowers of the novel world. The genus *Anthurium*, with over 700 species is the biggest in the family Araceae [1]. The name anthurium is derived from the Greek word. It is also known as painted tongue, flaming flower or Tail flower. Among the number of species available, the most popular and economically important species are *Anthurium andreanum* and *Anthurium scherzerianum*, which possess attractive long lasting inflorescence. It produces numerous inflorescences (spadices) subtended by brightly coloured spathes or bracts, which are carried on long, slender peduncles. The spathes are characteristically heart-shaped, flat, puckered and shiny. Day temperatures of 25°C to 28°C and night temperature of 18°C to 20°C is supposed to be best for anthurium cultivation. The desirable night temperature for vegetative growth is 18.3°C and for flowering 21°C to 23.9°C is needed [2]. Consequently, temperatures lower than 15°C and more than 35°C affects negatively. The optimum relative humidity of 60-80% is maintained for economic production of flowers. Anthurium is a shade loving plant hence proper provision of light and shade is utmost important.

Anthurium requires a best potting media, high organic compost, with good aeration drainage facility, low salt concentration and with good water retention capacity. It must be provided good anchorage, required pH (5.0) and EC (0.6 m. mhos/cm^2). It should have good structure and texture. Now a days, in many parts coconut husk and coco peat have been proved to be most popular media for anthurium cultivation. Foliar application of nutrients is easy and quick approach to provide its requirement. Nutrients needs of anthurium can be met through different sources, of which, major source chemical fertilizers. Keeping in view the limited studies and less available information regarding effect of foliar spray of primary nutrients, the present investigation "Effect of foliar spray of primary nutrients and their frequency of spray on anthurium (*Anthurium andreanum* L.) var. Xavia under protected conditions was carried out.

2. MATERIALS AND METHODS

The present investigation was conducted at the Polyhouse Complex, Department of Horticulture (Veg. and Flori.), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, situated in the core of the vast Indo-Gangetic plains of north eastern India at an altitude of 45.57 m~~eter~~ above mean sea level and lies at longitude of 87° 2' 42" east and latitude of 25° 15' 40'' north under subtropical to slightly semi-arid climatic condition. The maximum and minimum temperature during cropping period was recorded to be 33.2 °C and 25.1 °C, respectively. 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 size pots and maintained in net house under 75 per cent shade and 60-65 per cent relative humidity. Ten treatment combination involving five different doses/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 application of primary nutrients viz., F_1-once a week and F_2- twice a week, thus the total 10 treatment combinations was represented as D_1F_1-NPK (19:19:19) @ 1 g~~m~~/l once a week, D_1F_2-NPK (19:19:19) @1 g~~m~~/l twice a week, D_2F_1-NPK (19:19:19) @ 2 g~~m~~/l once a week, D_2F_2-NPK (19:19:19) @ 2 g~~m~~/l twice a week,D_3F_1- NPK (19:19:19) @ 3 g~~m~~/l once a week, D_3F_2-NPK (19:19:19) @ 3 g~~m~~/l twice a week, D_4F_1- NPK (19:19:19) @ 4 g~~m~~/l once a week, D_4F_2-NPK (19:19:19) @ 4 g~~m~~/l twice a week, D_5F_1-NPK (19:19:19) @ 5 g~~m~~/l once a week, and D_5F_2 -NPK (19:19:19) @ 5 g~~m~~/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 (0.5 g/l) plus magnesium sulphate (0.5 g/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 @ 0.5 g per liter. The important vegetative growth as length and breadth of leaf, plant spread, petiole length, number~~o.~~ of leaves per plant and flowering characters viz., days taken to first flower opening, period of inflorescence emergence to spathe unfurling, length of flower stalk, length and breadth of spathe, spadix length and diameter, no. of flower per plant and flower longevity on plant were recorded. All the mean values of the recorded data were statistically analyze and tabulated.

3. RESULT AND DISCUSSION

3.1 Vegetative growth parameters

3.1.1 Effect of different primary nutrients foliar spray

Application of different levels of primary nutrients exibit significant effect on various vegetative growth parameters, viz., length and breadth of leaves, plant spread, petiole length. Whereas, number of leaves per plant was not affected by different levels of primary nutrient spay (Table 1 & 2). Among different levels of primary nutrients, maximum leaf length (25.43 cm) and leaf breadth (15.32 cm) were recorded in treatment D_5, which was at par with D_3 and D_4 treatments. Maximum number of ~~leaf~~ leaves (4.47) was also recorded in D_5 treatment. The ~~P~~plants spread in N-S (60.92 cm) direction was recorded maximum under treatment D_5 which was at par with $D_4$and D_3 treatments. Similarly, maximum plant spread in E-W (61.03 cm) was recorded with treatment $D_{5,}$ which was at par with D_4 and D_3 treatments. The treatment D_5 ragistered significantly higher values for petiole length (35.51 cm) which was at par with treatment D_4. It might be due to optimum availability of the nutrients. Moreover, a suitable foliar primary nutrient combination such as nitrogen, phosphorus and potash, which is necessary for the synthesis of protein and cytokinin, consequently affects cell division. Similar results were obtained by ~~Srinivasa and Reddy~~ [3~~]~~, ~~Babloo and Singh [~~4~~] and Barad *et al.*~~, [5]~~)~~.

3.1.2 Effect of frequencies of the primary nutrient spray

In case of frequencies of the foliar spray, the higher growth of vegetative characters viz. leaf length and breadth, plant spread and petiole length were recorded in F_2 i.e. spray twice a week as compared to F_1 i.e. spray once a week for the same characters. 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 [6]. These results are in parallel with those reported by~~ Sunitha et al.~~ [7,~~]~~ ~~and Gaur et al.~~[8].

3.1.3 Interaction effect

Interaction effect of different levels of primary nutrients and their frequencies per week failed to exhibit any significant effect on various vegetative growth parameters.

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

Fertilizer doses	Number of leaf/plant			Leaf length (cm)			Leaf breadth (cm)		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
D_1- NPK (19:19:19) @ 1 g~~m~~/l	4.00	4.13	4.07	23.80	24.02	23.91	13.93	14.21	14.07
D_2- NPK (19:19:19) @ 2 g~~m~~/l	4.20	4.33	4.27	23.93	24.25	24.09	14.10	14.65	14.38
D_3- NPK (19:19:19) @ 3 g~~m~~/l	4.27	4.40	4.33	24.21	25.49	24.85	14.48	15.17	14.82
D_4-NPK (19:19:19) @ 4 g~~m~~/l	4.33	4.47	4.40	24.55	25.88	25.22	14.74	15.45	15.10
D_5-NPK (19:19:19) @ 5 g~~m~~/l	4.40	4.53	4.47	24.85	26.02	25.43	15.15	15.48	15.32
Mean	4.24	4.37		24.27	25.13		14.48	14.99	
	D	**F**	**D*F**	**D**	**F**	**D*F**	**D**	**F**	**D*F**
S.~~-~~Em. ±	0.10	0.07	0.15	0.36	0.22	0.50	0.26	.016	0.36
C.D. at 5%	NS	NS	NS	1.05	0.66	NS	0.75	0.48	NS
C. V. %	5.78			3.52			4.25		

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Table 2. Effect of foliar spray of primary nutrients and their frequencies on Vegetative growth of anthurium (*Anthurium andreanum* L.) var. Xavia

Fertilizer doses	**Plant spread North-South (cm)**			**Plant spread East-West (cm)**			**Petiole length (cm)**		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
D_1- NPK (19:19:19) @ 1 g~~m~~/l	55.57	56.17	55.87	55.17	56.25	55.71	30.35	32.84	31.59
D_2- NPK (19:19:19) @ 2 g~~m~~/l	55.75	59.00	57.38	56.33	58.28	57.31	31.28	33.64	32.46
D_3- NPK (19:19:19) @ 3 g~~m~~/l	58.75	60.42	59.58	58.00	60.23	59.12	33.33	34.31	33.82
D_4-NPK (19:19:19) @ 4 g~~m~~/l	59.08	61.50	60.29	58.47	62.32	60.39	33.78	36.79	35.28
D_5-NPK (19:19:19) @ 5 g~~m~~/l	59.17	62.67	60.92	59.68	62.37	61.03	34.27	36.76	35.51
Mean	57.66	59.95		57.53	59.89		32.60	34.87	
	D	**F**	**D*F**	**D**	**F**	**D*F**	**D**	**F**	**D*F**
S.-Em. ±	1.01	0.64	1.42	0.86	0.54	1.22	0.43	0.72	0.61
C.D. at 5%	2.96	1.88	NS	2.54	1.61	NS	1.26	0.80	NS
C. V. %	4.19			3.59			3.11		

3.2 Flowering, yield and quality parameters

3.2.1 Effect of different primary nutrients foliar spray

Different levels of primary nutrients significantly influence days to first flower opening, length and breadth of spathe, flower stalk length, spadix length and number of flower per plants. The minimum days to first flower opening (91.47 days) was recorded in treatment D_5 which was at par with D_4 treatment. The early flowering was probably due to increased availability of nutrients during the vegetative (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

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findings of ~~Jawaharlal et al. ~~[9~~]~~, ~~Srinivasa and Reddy [~~3,~~]~~ ~~(2005) and Gurjar et al. [~~10] in anthurium. In case of spathe length (9.49 cm) was recorded maximum in D_4 which was at par with D_5 (9.48 cm) and D_3 (9.18 cm). Whereas, maximum spathe breadth (8.20 cm) was recorded in treatment D_5. The maximum flower stalk length (28.43 cm) was also recorded in treatment D_5 which was at par with D_4 and D_3 treatments. Number of flowers per plant was noted significantly maximum (3.63) in the treatment D_5 which was at par with D_4 (3.53). These findings may be attributed to the optimum levels of balanced NPK nutrition enhances better photosynthetic activity and production of carbohydrates, which helps in better partitioning of nutrients from source to sink. These results are in agreement with the results of ~~Srinivasa and Reddy ~~[3~~]~~, ~~Jadhav, et al. [~~11,~~] and Gurjar et al. [~~10] in anthurium.

3.2.2 Effect of frequencies of primary nutrient spray

Frequencies of primary nutrients spray significantly affected the number of days required for first flowering. Anthurium plants sprayed with nutrients twice in a week (F_2) took the minimum days to first flower opening (93.55 days). It might be due to optimum availability of the nutrients. These results are in line with ~~Gurjar *et al.* (2012)~~[10] in anthurium. The maximum spathe length (9.36 cm) and breadth (8.02 cm) were recorded in treatment F_2. Whereas, minimum spathe length (8.88 cm) and breadth (7.74 cm) were observed in treatment F_1. It is clear from the data that frequency of the nutrients spray significantly influenced the flower stalk length. The maximum flower stalk length (28.13 cm) was recorded in F_2 *i.e.* spray twice a week, while minimum stalk length (26.62 cm) in treatment F_1. The significantly maximum number of flowers per plant (3.42) was recorded in F_2 treatment. The higher growth of spathe and flower stalk length might be due to optimum availability of nutrients and good growth and development of plant. These results are in agreement with the results of ~~Srinivasa and Reddy ~~[3,~~] and Gurjar *et al.* [~~10].

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3.2.3 Interaction effect

The data presented in the Table 3 & 4 revealed that the interaction effect of primary nutrient foliar spray and frequencies were significant in case of flowering and yield characters, except spadix length. The minimum days required for first flower opening (90.93 days) was recorded in D_5F_2 treatment, which was at par with D_4F_2 (91.13 days), D_3F_2 (91.27 days) and D_5F_1 (92.00 days). The maximum spathe length (9.98 cm) and spathe breadth (8.30 cm) was found in D_5F_2, and D_4F_2, respectively. The maximum flower stalk length (29.17 cm) was recorded in treatment combination of D_4F_2 which was at par with D_5F_2 (28.62 cm), D_3F_2 (28.50 cm) and D_5F_1 (28.23 cm) treatments. It might be due to optimum availability of the nutrients rather than excess. Moreover, a suitable foliar nutrient combination such as nitrogen, phosphorus and potash, which is necessary for the synthesis of protein and cytokinin, consequently affects cell division. Similar results were obtained by Srinivasa and Reddy [3]. The treatment combination of D_5F_2 recorded maximum yield of flowers per plant (4.13) which was at par with D_4F_2. It might be due to balance dose of NPK which increase the vegetative growth, favourable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for flower development [12].

Table 3. Effect of foliar spray of primary nutrients and their frequencies on flowering and quality of anthurium (*Anthurium andreanum* L.) var. Xavia

Fertilizer doses	Days to first flower opening			Spathe length(cm)			Spathe breadth (cm)		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
D_1- NPK (19:19:19) @ 1 g~~m~~/l	99.47	98.93	99.20	8.64	8.68	8.66	7.35	7.43	7.39
D_2- NPK (19:19:19) @ 2 g~~m~~/l	99.20	95.47	97.33	8.63	8.96	8.80	7.37	8.02	7.69
D_3- NPK (19:19:19) @ 3 g~~m~~/l	98.47	91.27	94.87	8.81	9.55	9.18	7.84	8.14	7.99
D_4-NPK (19:19:19) @ 4 g~~m~~/l	94.53	91.13	92.83	8.99	9.98	9.49	8.05	8.22	8.14
D_5-NPK (19:19:19) @ 5 g~~m~~/l	92.00	90.93	91.47	9.35	9.61	9.48	8.10	8.30	8.20
Mean	96.73	93.55		8.88	9.36		7.74	8.02	
	D	**F**	**D*F**	**D**	**F**	**D*F**	**D**	**F**	**D*F**
S.-Em. ±	0.76	0.48	1.01	0.11	0.07	0.16	0.06	0.04	0.09
C.D. at 5%	2.24	1.41	3.16	0.33	0.21	0.47	0.19	0.12	0.27
C. V. %	1.95			3.03			2.02		

Table 4. Effect of foliar spray of primary nutrients and their frequencies on flower quality and yield of anthurium (*Anthurium andreanum* L.) var. Xavia

Fertilizer doses	Flower stalk length (cm)			Spadix length (cm)			No. of flower stalks/plant		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
D_1- NPK (19:19:19) @ 1 g~~m~~/l	23.63	27.08	25.35	4.32	4.45	4.38	2.40	2.82	2.61
D_2- NPK (19:19:19) @ 2 g~~m~~/l	26.64	27.27	26.95	4.38	4.54	4.46	2.60	3.03	2.82

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D_3- NPK (19:19:19) @ 3 g~~m~~/l	27.25	28.50	27.88	4.49	4.65	4.57	2.88	3.13	3.01
D_4-NPK (19:19:19) @ 4 g~~m~~/l	27.35	29.17	28.26	4.60	4.74	4.67	3.07	4.00	3.53
D_5-NPK (19:19:19) @ 5 g~~m~~/l	28.23	28.62	28.43	4.63	4.77	4.70	3.13	4.13	3.63
Mean	26.62	28.13		4.48	4.63		2.82	3.42	
	D	**F**	**D*F**	**D**	**F**	**D*F**	**D**	**F**	**D*F**
S.-Em. ±	0.35	0.25	0.49	0.08	0.05	0.12	0.04	0.02	0.05
C.D. at 5%	1.02	0.64	1.44	NS	NS	NS	0.11	0.07	0.16
C. V. %	3.09			4.37			3.01		

4. CONCLUSION

From the result obtained in this investigation, it can be concluded that anthurium variety Xavia responded well to different levels of primary nutrients (NPK) and their frequencies under protected conditions for growth, flowering, quality and yield. In this study, among all treatments, D_5F_2 (NPK 19:19:19 @ 5 g~~m~~/l twice a week) found to be best in terms of vegetative growth, flowering yield and quality of anthurium as it recorded maximum values for all the characters. Based on these findings, it is recommended that the application of water soluble fertilizer (19:19:19 NPK) at the rate of 5 g/l twice a week foliar spray under shade net house is suitable for the successful growth, yield and quality of anthurium var. Xavia for higher productivity.

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