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Effect of Fertigation Levels on Yield and Quality Parameters of Different Varieties of Anthurium (*Anthurium andreanum* Lind.) under Shadehouse Condition

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ABSTRACT

An investigation was carried out to study the effect of different fertigation levels on yield and quality of different varieties of anthurium (Anthurium andreanum Lind.) under shadehouse condition was conducted at the Floriculture section, Regional Horticultural Research and Extension Centre, University of Horticultural Sciences Campus, GKVK, Bengaluru during 2015-2016. The experiment was laid out with eight treatment combinations involving four levels of fertigation on two commercial anthurium varieties namely Tropical and Xavia, to assess the effect on flower yield and quality parameters. Highest stalk length (68.20 cm), stalk diameter (7.60 mm), spathe length (18.33 cm), spathe width (12.61 cm), spadix angle (34.95^o), number of flowers per plant (8.75), per m^2 (61.25) and per hectare (4.90 lakh), first grade flowers (71.81%), cumulative water uptake (73.17 g), minimum cumulative transpiration loss (44.46 g), fresh weight (47.75 g) and vase life (27.0 days) was recorded in F_3 fertigation level. Among the varieties maximum stalk length (64.46 cm), stalk diameter (7.52 cm), spathe length (18.24 cm), grade I flowers (68.75%), cumulative water uptake (62.85 g), less cumulative transpiration loss (60.18 g), fresh weight (49.08 g) and vase life (25.83 days) were recorded in cv. Xavia, whereas spathe width (12.12 cm), spadix angle (40.33^o), number of flowers per plant (7.63), per m^2 (53.43) and per hectare (4.27 lakh) were observed in cv. Tropical. Among the interactions, treatment combination F_3V_2 recorded for significantly highest stalk length (70.34 cm), spathe length (18.99 cm) and first grade flowers (74.5%), whereas F_3V_1 recorded maximum spathe width (13.35 cm).

Key words: *Anthurium, Cultivars, Fertigation, Shadehouse, Yield and Quality*

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INTRODUCTION

Anthurium (*anthurium andreanum*) is one of the most important tropical ornamental plant grown for its colourful spathe and attractive foliage. They are very popular as cut flowers for their beauty, bold and long lasting qualities which are essential pre-requisites for any floral arrangement. Due to its increasing popularity, there is very good demand for the flowers both in domestic and export markets. The anthurium is grown in the states of Kerala, Karnataka, Maharashtra, North-Eastern states, parts of Madhyapradesh, Jharkhand, Himachal Pradesh and Chhattisgarh. The flower has good demand in domestic and international market, which makes it economically viable crop. Due to the increasing popularity it occupies 11th position among the cut flowers in the international market. The area coverage under anthurium in India is 130 hectares with a production of 2500 MT of cut flowers and in Karnataka the production is 160 MT[1].

Anthurium is perennial, semi-terrestrial, evergreen and herbaceous plants with oblong, heart shaped leaves and spathe. The flower consists of a colourful modified leaf called spathe and hundreds of small spirally arranged bisexual flowers on a pencil like structure called spadix, arising from the base of the spathe. Anthurium flowers with good keeping quality fetch a good market price. The cut flower production in shadehouse has been found to be a viable proposition in obtaining high quality flowers and also it is cost effective.

Fertigation is a technique of applying nutrients through micro irrigation systems directly at the site of active root zone. It has potential for more accurate and timely crop nutrition leading to increased yields and enhanced quality. Fertigation helps in reducing the wastage of nutrients through enhanced fertilizer use efficiency, besides providing flexibility in timing of fertilizer application in relation to crop demand based on physiological stages of growth[11].

MATERIAL AND METHODS

The investigation was conducted during 2015-2016 to study the effect of varied levels of fertigation on yield and flower quality of different varieties of anthurium (*Anthurium andreanum* Lind.) under shadehouse condition at Floriculture section, Regional Horticultural Research and Extension Centre, University of Horticultural Sciences, Bagalkot campus, GKVK, Bengaluru-65. The research plot is situated between 13.05^{o} latitude and 77^{o} East longitude at an altitude of 924 m above mean sea level. The climate of the area is mild with mean annual rainfall of about 73.31 mm. The mean maximum temperature vary from 25.3°C to 35.80°C and the mean minimum temperature vary from 14.7°C to 23.1°C. The minimum and maximum relative humidity was 60-90 per cent.

The experiment was conducted on two year old plants at a spacing of 45 cm × 30 cm. The media of the experimental site consisting of cocopeat, farm yard manure and sand in the ratio 2:1:1 with a neutral pH of 6.36. The experiment was laid out in factorial randomized complete block design (FRCBD) with eight treatments *viz.*, four fertigation levels (F_0-200:100:250 kg NPK/ha through soil application, F_1-150:75:187.5, F_2-200:100:250 and F_3-250:125:312.5 kg NPK/ha through fertigation) and two varieties (V_1-Tropical and V_2-Xavia). The treatments were replicated thrice. $CaCO_3$ (5 g/plant) was applied per month as foliar spray and fertigation was given at fortnightly interval through water soluble fertilizers like 19:19:19, potassium nitrate and urea.

RESULTS AND DISCUSSION

The data pertaining to the flower characters are presented in the Table 1. Among the levels of fertigation tried, the plots receiving 250:125:312.5 kg NPK/ha (F_3) recorded higher stalk length (68.20 cm), stalk diameter (7.60 mm), spathe length (18.33 cm), spathe width (12.61 cm) and spadix angle (34.95^{o}). This might be due to optimum availability of the nutrients. Moreover, a suitable 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

Jadhav *et al.*[7], Gurjar *et al.*[5], Cuquel *et al.*[2], and Srinivasa and Reddy[15] in anthurium.

Among the varieties, maximum stalk length (64.46 cm), stalk diameter (7.52 cm) and spathe length (18.24 cm) was observed in cv. Xavia whereas cv. Tropical recorded for highest spathe width (12.12 cm) and spadix angle (40.33^o). This may be due to better growth traits of the varieties had, which helped in the better performance of the variety and also the genetic potentiality of the varieties Agasimani *et al.*[1], Shiva and Sujatha[13] and Rajeevan *et al.*[12], in anthurium. In interaction effect, treatment combination F_3V_2 recorded for significantly highest stalk length (70.34 cm) and spathe length (18.99 cm) whereas F_3V_1 recorded maximum spathe width (13.35 cm). This is mainly due to differential response of variety at a given fertigation level.

The fertigation levels had significant influence on number of flowers per plant per annum as shown in Table 2. Fertigation level F_3 exhibited maximum number of flowers per plant (8.75), per m^2 (61.25) and per hectare (4.90 lakh) followed by F_2, F_1 and F_0. These results indicates that higher dose of fertigation resulted in better yield of flowers due to increased supply of nutrients, healthy and vigorous plants than all other treatments, Jadhav *et al.*[7], Jawaharlal *et al.*[8]. Gopinath and Chandrashekar[4]. Dufour *et al.*[3], and Karuna *et al.*[9] , in anthurium.

Varieties differed significantly in their number flowers per plant, per m^2 and per hectare. The cv. Tropical recorded highest number of flowers per plant (7.63), per m^2 (53.43) and per hectare (4.27 lakh) followed by cv. Xavia. The difference in number of flowers might be due to different genetic potentiality of the varieties. Similar observations were recorded by Agasimani *et al.*[1], Srinivasa and Reddy[15] and Jawaharlal *et al.*[8], in anthurium.

Significant differences were observed in different fertigation levels with respect to flower grades of anthurium cut flowers (Table 3). Maximum number of grade I flowers (71.81%) were obtained in F_3 (250:125:312.5 kg NPK/ha) whereas, it was lowest in control (58.72%). In regard to commercial classification of anthurium flowers it was affected by the fertigation levels. The biggest spathes, which is one of the anthurium quality parameters[2], was observed with higher nutrients applied.

The influence of varieties were found significant on production of Grade I, Grade II and Grade III cut flowers. The maximum grade I flowers were found in cv. Xavia (68.75%), and it was lowest in cv. Tropical (61.69%). Then production of grade II and grade III flowers were highest (31.76 and 6.53%) in the cv. Tropical and it was lowest in cv. Xavia (26.24 and 4.99% respectively). These variations might be attributed to genetic makeup and physiological difference among genotypes as reported by Agasimani *et al.*[1], in anthurium.

Significant effect was also found with respect to interaction between fertigation levels and varieties. The treatment combination F_3 x V_2 (250:125:312.5 kg NPK/ha x cv. Xavia) produced highest grade I flowers (74.50%). Higher dose of fertigation resulted in better quality flowers due to increased supply of nutrients, healthy and vigorous plants than all the other treatments and also the genetic potential of the varieties.

Results of vase life study are presented in Table 4. Cumulative water uptake (73.17 g), minimum cumulative transpiration loss (44.46 g), fresh weight (47.75 g) and vase life (27.0 days) were significantly higher in F_3 fertigation level compared to others. This might be due to increased levels of nitrogen, phosphorous and potassium uptake might have decreased the water loss and helped in maintaining the water potential in a constant state which in turn might have maintained the turgidity. Calcium is particularly an important nutrient in plants because of its role in membrane function promoting translocation of sugars and auxin, helping to prevent senescence. The research finding was in conformity with the reports of Jadhav *et al.*[7], and Waikar and Jadhav[16] in anthurium.

Among the varieties, cv. Xavia recorded higher cumulative water uptake

(62.85 g), less cumulative transpiration loss (60.18 g), maximum fresh weight (49.08 g) and vase life (25.83 days). It can be connected to the thicker and longer stems of cut flowers, with big and bold sized flowers as well as large water and food conducting tissues. Accumulation of higher metabolites might have influenced maximum water uptake and highest vase life. Similar such findings are in agreement with the findings of Handargall[6] and Maitra and Roychowdhury[10]. in anthurium.

Table 1: Stalk length, stalk diameter, spathe length, spathe width and spadix angle of anthurium varieties as influenced by fertigation and their interaction

Treatments	Stalk length (cm)	Stalk diameter (mm)	Spathe length (cm)	Spathe width (cm)	Spadix angle (°)
Fertigation levels					
F_0	57.37	6.52	16.72	10.21	31.65
F_1	60.92	7.04	17.36	10.99	32.75
F_2	64.35	7.35	17.83	11.75	34.10
F_3	68.20	7.60	18.33	12.61	34.95
CD (P=0.05)	2.78	0.31	0.64	0.26	2.27
Varieties					
V_1	60.95	6.74	16.88	12.12	40.33
V_2	64.46	7.52	18.24	10.66	26.39
CD (P=0.05)	1.97	0.21	0.45	0.18	1.60
Interactions (Fertigation levels x Varieties)					
F_0 x V_1	55.21	6.23	16.09	10.66	38.96
F_1 x V_1	59.51	6.77	16.66	11.76	39.79
F_2 x V_1	63.02	6.96	17.09	12.72	40.67
F_3 x V_1	66.05	6.98	17.67	13.35	41.90
F_0 x V_2	59.51	6.81	17.36	09.76	24.23
F_1 x V_2	62.34	7.13	18.06	10.23	25.71
F_2 x V_2	65.68	7.71	18.56	10.78	27.53
F_3 x V_2	70.34	8.24	18.99	11.87	28.00
CD (P=0.05)	1.37	NS	0.90	0.37	NS

F_0 - 200:100:250 kg NPK/ha (soil application) F_1 -150:75:187.5 kg NPK/ha F_2 -200:100:250 kg NPK/ha
F_3 (250:125:312.5 kg NPK/ha) V_1 (Tropical) V_2 (Xavia) NS - Non Significant

Table 2: Number of flowers per plant, per square metre and per hectare of anthurium varieties as influenced by fertigation levels and their interaction

Treatments	Number of flowers		
	Per plant	Per m^2	Per hectare (Lakh)
Fertigation levels			
F_0	5.85	40.95	3.27
F_1	6.71	47.01	3.76
F_2	7.68	53.78	4.30
F_3	8.75	61.25	4.90
CD (P=0.05)	0.52	3.69	0.29
Varieties			
V_1	7.63	53.43	4.27
V_2	6.86	48.06	3.84
CD (P=0.05)	0.37	2.61	0.20
Interactions (Fertigation levels x Varieties)			
F_0 x V_1	6.13	42.93	3.43
F_1 x V_1	7.06	49.46	3.95
F_2 x V_1	8.10	56.70	4.53
F_3 x V_1	9.23	64.63	5.17
F_0 x V_2	5.56	38.96	3.11
F_1 x V_2	6.36	44.56	3.56
F_2 x V_2	7.26	50.86	4.06
F_3 x V_2	8.26	57.87	4.62
CD (P=0.05)	NS	NS	NS

F_0 - 200:100:250 kg NPK/ha (soil application) F_1 -150:75:187.5 kg NPK/ha F_2 -200:100:250 kg NPK/ha
F_3 (250:125:312.5 kg NPK/ha) V_1 (Tropical) V_2 (Xavia) NS - Non Significant

Table 3. Flower grades based on spathe size as influenced by fertigation levels and varieties in anthurium under shadehouse condition

Treatments	Grade I (13-15 cm)	Grade II (11-13 cm)	Grade III (9-11 cm)
Fertigation levels			
F_0	58.72 (50.03)	31.14 (33.92)	10.12 (18.39)
F_1	62.52 (52.29)	31.18 (33.89)	6.29 (14.49)
F_2	67.85 (55.49)	28.18 (32.00)	3.96 (11.41)
F_3	71.81 (57.96)	25.50 (30.25)	2.68 (9.02)
CD (P=0.05)	0.92	1.88	1.92
Varieties			
V_1	61.69 (51.84)	31.76 (34.28)	6.53 (14.21)
V_2	68.75 (56.08)	26.24 (30.75)	4.99 (12.45)
CD (P=0.05)	0.65	1.33	1.36
Interactions (Fertigation levels x Varieties)			
F_0 x V_1	56.03 (48.46)	31.56 (34.18)	12.40 (20.60)
F_1 x V_1	57.43 (49.27)	35.73 (36.71)	6.84 (15.16)
F_2 x V_1	64.20 (53.25)	32.50 (34.76)	3.29 (10.45)
F_3 x V_1	69.13 (56.25)	27.27 (31.47)	3.60 (10.63)
F_0 x V_2	61.42 (51.60)	30.73 (33.63)	7.85 (16.18)
F_1 x V_2	67.61 (55.32)	26.64 (31.07)	5.74 (13.82)
F_2 x V_2	71.49 (57.74)	23.87 (29.24)	4.63 (12.38)
F_3 x V_2	74.50 (59.67)	23.73 (29.03)	1.77 (7.42)
CD (P=0.05)	1.30	2.66	2.72

F_0 - 200:100:250 kg NPK/ha (soil application) F_1 -150:75:187.5 kg NPK/ha F_2 -200:100:250 kg NPK/ha
F_3 (250:125:312.5 kg NPK/ha) V_1 (Tropical) V_2 (Xavia) NS - Non Significant

Table 4: Vase life studies as influenced by fertigation levels and varieties in anthurium

Treatments	Cumulative water uptake (g)	Cumulative transpiration loss (g)	Fresh weight of flower (g)	Vase life (days)
Fertigation levels				
F_0	43.37	67.66	37.16	20.50
F_1	48.74	61.31	40.83	22.66
F_2	61.70	51.56	44.16	25.16
F_3	73.17	44.46	47.75	27.00
CD (P=0.05)	7.43	10.12	2.50	2.22
Varieties				
V_1	51.35	60.18	35.87	21.83
V_2	62.85	52.31	49.08	25.83
CD (P=0.05)	5.25	7.15	1.77	1.57
Interactions (Fertigation levels x Varieties)				
F_0 x V_1	35.59	70.36	30.16	18.33
F_1 x V_1	44.25	67.12	35.66	20.00
F_2 x V_1	56.11	52.82	36.83	23.33
F_3 x V_1	66.48	50.45	40.83	25.66
F_0 x V_2	48.12	64.96	44.16	22.66
F_1 x V_2	52.79	55.51	46.00	25.33
F_2 x V_2	69.91	50.30	51.50	27.00
F_3 x V_2	78.80	38.46	54.66	28.33
CD (P=0.05)	NS	NS	NS	NS

F_0 - 200:100:250 kg NPK/ha (soil application) F_1 -150:75:187.5 kg NPK/ha F_2 -200:100:250 kg NPK/ha
F_3 (250:125:312.5 kg NPK/ha) V_1 (Tropical) V_2 (Xavia) NS - Non Significant

CONCLUSION

From these findings, it can be concluded that cv. Tropical yielded better quality flowers in F_3 fertigation level whereas, cv. Xavia recorded maximum vase life days with F_3 fertigation level as compared to cv. Tropical.

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