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Research Article

Evaluation of different varieties of anthurium (*Anthurium andraeanum* Linden Ex André) for cut flower product ion under Shevaroys Hills

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Abstract
A study was conducted to evaluate thirteen anthurium cultivars at Horticultural Research Station, Tamil Nadu Agricultural University, Yercaud during 2012 - 2014 for quantitative and qualitative characters. Significant differences were observed for all the characters studied. The cultivar Claisto recorded the highest plant height (66.00 cm) and Fantasia recorded the maximum plant spread (73.20 cm). Cultivars Fantasia and Calsito produced the maximum number of leaves per plant (5.0). The leaf length was maximum in Calisto (33.54 cm) and minimum leaf breadth was recorded in Marysia (13.40 cm). The maximum number of suckers was recorded in Cultivars Lumina (3.14 no) and Rosa, Titicaca and Angel (3.04 no).With respect to the floral parameters cultivar Calisto recorded maximum petiole length (37.00 cm) and highest stalk length (41.00 cm). Fantasia and Calisto recorded the highest spathe length (12.67 cm) followed by Lumina (12.50 cm) and DO 32 (11.15 cm). Fantasia recorded the highest Spathe width of 13.50 cm and highest spadix length of 6.59 cm. Maximum number of spikes per plant per year was in cultivar Calisto (8.00 nos). The effect of holding solutions on the vase life of cut spikes was assessed. Among them, Sucrose 5%+ $Al_2(SO_4)_3$ 300ppm + Kinetin 25ppm showed the highest vase life of 29.00 days recoreded in Calisto followed by Fanstasia (28 days) and Titicaca (27.00 days).It could be concluded from the present investigation that out of thirteen cultivars evaluated the cultivar Fanstasia and Calisto were found to be the best cultivars both in yield and quality for cut flower production under Shevaroy condition of Eastern Ghat.

Key words
Anthurium, cultivars, holding solutions

Introduction

Anthurium assumes significant position on account of its beauty. It is grown for its showy cut flowers and attractive foliage. Anthurium ranks ninth in the global cut flower trade and commands a respectable price both for cut flower and whole plant. In India, the anthurium cut flower industry is still in its infancy. They are very popular with flower arrangers because of the bold effect and long lasting qualities of flower when cut. The long shelf-life of anthurium symbolizes a long, healthy life. Major countries importing anthurium are USA, Germany and Japan. In India, a few growers in Kerala, Tamil Nadu, Karnataka, Maharashtra and West Bengal have started growing anthurium on a large scale. Anthurium Characteristically produces numerous inflorescences subtended by brightly colored spathes, which are carried on long, slender peduncles. Spathes are characteristically heart-shaped, flat, puckered and shiny and flowers have a wide range of spathe colors *viz.*, white, pink, salmon-pink, red, light-red, dark-red, brown, green, lavender, cream or multi-colored. The colorful spathe is long-lasting. However, the 'true' flowers are found on the spadix and have large numbers of pistils, each surrounded by four stamens. There is a growing interest among the farmers of shevaroys region for growing Anthurium because of high returns. Hence there is a to evaluate some of the leading anthurium cultivars for cut flower production so that, suitable variety could be recommended for Shevaroys region.

Materials and Methods

The present investigation was carried out at Horticultural Research Station, Tamil Nadu Agricultural University, Yercaud during 2012-2014. The experimental site is situated between 11° 04" to 11° 05" North latitude and 78° 05" to 78° 23" East longitude and at an altitude of 1500 m above Mean Sea Level. The average minimum and maximum temperature of the area were 12.4^{o}C and31.0^{o}C respectively. The soil is laterite in texture with 0.5 to 1.5 m depth. The experiment was laid out in a Randomized Block Design with three replications. Thirteen Anthurium cultivars *viz.*, Acropolis, Angel, Calisto, Cheers, DO 32, Fantasia, Fire, Lumina, Marysia, Midori, Rosa, Titicaca and Xavia were collected from M/s Florance and Flora, Bangalore are used for the trial. Uniform sized seedlings were planted during June 2011; five plants from each cultivar in each replication were selected for recording observation on plant height (cm), number of leaves, number of suckers/plant/year, plant spread(cm), leaf length (cm), leaf breadth (cm), stalk length, spathe length (cm), spathe width (cm), spadix length, number of spikes per plant per year, vase life (d) and vase life in water (days). The effect of holding solutions on the post harvest life of cut spikes was assessed in all the thirteen varieties. The spikes were

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harvested when 25-75% flowers were open in the spadix and the freshly harvested stem were put in to different holding solutions. The different vase life treatments are as follows H_1: $Al_2(SO_4)_3$. $16H_2O$ - 300 ppm, H_2 : $Al_2(SO_4)_3$. $16H_2O$ - 300 ppm + Kinetin - 25 ppm H_3 : Sucrose 5% + $Al_2(SO_4)_3$, $16H_2O$ – 300 ppm,H_4 : Sucrose 5% + Kinetin – 25 ppm,H_5 : Sucrose 5% + $Al_2(SO_4)_3$, $16H_2O$ – 300 ppm + Kinetin – 25 ppm,H_6 : Control (Double distilled water) After recutting the basal portion of the stem (2 cm) under water and the vase life was evaluated at 23 ± 2°C and 16 h illumination (1000 lux intensity provided by 40 W fluorescent tubes) under laboratory conditions. The genotypic and phenotypic correlation coefficients were calculated by the formulae suggested by (Panse and Sukhatme, 2000).

Results and Discussion

Data presented in (Table 1) showed that there was significant variation in vegetative characters. The cultivar Claisto recorded the maximum plant height (66.00 cm) followed by Fantasia (59.50 cm), Acropolis (54.50 cm) and Rosa (52.50 cm). While, the least plant height was noticed in Marysia (24.00 cm). Cultivar Fantasia recorded the maximum plant spread (73.20 cm) followed by Calisto (67.25 cm) and Rosa (42.50 cm) which were significantly superior to other cultivars. The minimum plant spread (19.00 cm) was recorded in Marysia. Cultivars Fantasia and Calsito produced the maximum number of leaves per plant (5.0). The minimum number of leaves per plant (3.00) was recorded in Cultivar DO 32. Variations in leaf production could be expected among the cultivars as the attribute to a genetic character. These results are in conformity with the reports of Agasimani *et al.,* (2011). The highest leaf length was noticed in Calisto (33.54 cm) followed by Titicaca (31.92) and Midori (21.73 cm) which recorded the lowest leaf length. Fantasia recorded the maximum leaf breadth of (25.50 cm) and minimum was recorded in Marysia (13.40 cm). These results are in accordance with the findings of Femina *et al.,* (2006) in Anthurium . The maximum number of suckers was recorded in Cultivars Lumina (3.14) and Rosa, Titicaca and Angel (3.04) recorded which was superior over other cultivars, while Acropolis recorded minimum number of suckers per plant (1.01). Production of suckers is highly cultivar dependent. Being genetically controlled factor, the suckers' production varied among the cultivars. These results are in line with that of Shriram *et al*., (2008) in anthurium.

With respect to the floral parameters all the characters differed significantly and it is presented in table 2. The maximum petiole length was recorded in Calisto (37.00 cm) followed by Fantasia (33.00 cm) and Angel (29.20 cm). Cultivar Calisto recorded the highest stalk length of 41.00 cm followed by Fantasia (38.00 cm), Fire and Lumina (33.00 cm) respectively. The lowest stalk length was recorded in the Angel and Titicaca (18.00 cm) which was inferior to other cultivars. Similar results were recorded by Islam *et al., (*2013). Among the different cultivars studied cv. Fantasia and Calisto recorded the highest spathe length (12.67 cm) followed by Lumina (12.50 cm) and DO 32 (11.15 cm). Similar results were recorded by Agasimani *et al.,* (2010). Spadix width was varied from 5.00 cm to 13.50 cm .The Spathe width was the highest in Fantasia (13.50 cm) and Rosa (10.50 cm), while the cv. Marysia had the least Spathe width of 5.00 cm. In the present study cv. Fantasia recorded the highest spadix length of 6.59 cm followed by Midori (6.30 cm) and Calisto (6.08 cm), the least spadix length was recorded by Marysia (4.05 cm). A temperature of 15°C to maximum of 30°C and relative humidity of 60 - 70% is ideal for the growth, which may influence the spathe breadth and varied among cultivars (Rajeevan et al. (2007).Numbers of spikes per plant ranged from 2.00 to 8.00 nos. Maximum number of spikes per plant was recorded by Cultivar Calisto (8.00) followed by Fantasia (7.00). The lowest spikes per plant were recorded in Marysia and Angel (2.00 nos). The number of spikes per plant is genetically controlled factor. Similar results were noticed for flower production by Islam. *et al*., (2013) and Rajeevan *et al*., (2007). Morphological traits of Anthurium cultivars were classified based on spathe and spadix color is furnished in table 3.

In the present study, genotypic and phenotypic correlation coefficients and path-coefficient analysis were carried out in anthurium cultivars for 12 quantitative characters which were presented in table 4. The estimate of genotypic correlation coefficient was higher than the corresponding phenotypic correlation coefficient. In genotypic correlation studies number of spikes per plant was found to be positively and significantly correlated with plant height (0.747), plant spread (0.740) ,number of leaves (0.321), leaf length (0.819), leaf breadth (0.600),number of suckers(0.167),petiole length (0.759), stalk length (0.687), spathe length (0.665), spathe width (0.720) and spadix length (0.450). This is in consonance with results of Shiva and Sujatha Nair 2008. Path co-efficient analysis revealed and presented in table 5. The plant height (0.850), number of leaves (0.260), leaf length (0.177), leaf breadth (0.925), number of suckers (0.110), petiole length (0.330) and spathe length (0.310) were found to be positive effect with yield. While it was negative for plant spread (-0.620), stalk length (-0.101), spadth width (-0.107) and spadix lenght (-0.715). The direct effect was the highest (0.925) for leaf breadth followed by plant height (0.850) and petiole length (0.330). Plant spread had the highest indirect effect on leaf breadth (0.557). This is in conformity with reports of Anand *et al.,* 2013 and Priyasree Sarma Tamuli

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et al., 2015. Considering correlation and path coefficients of the characters *viz*., plant height, leaf length, leaf breadth,number of suckers, spathe length, spathe width and spadix length emerged out as an important component for yield in anthurium.

Post harvest life or vase life of cut flower is the ultimate requirement of any flower production technology. Though the post harvest life of Anthurium is genetically controlled and sometimes influenced by the size of flowers and harvesting stages, it can also be improved by the use of floral preservatives upto a certain limit (Sahare and Alka Singh, 2015). The effect of holding solutions on the vase life of cut spikes was assessed and the results are presented in the table 6. All the holding solutions performed better than the flowers kept in distilled water. The flowers treated with the holding solution containing Sucrose 5%+ $Al_2(SO_4)_3$ 300ppm + Kinetin 25ppm showed the highest vase life of (29.00 days) recorded in Calisto followed by Fanstasia (28 days) and Titicaca (27.00 days). Significant differences had been observed between the effects of different holding solutions on the various aspects of post harvest life of cut anthurium spikes. Flowers kept in distilled water recorded the minimum vase life of 10 days in Marysia. Varieties as well as cultivars differ in their vase life (Harishshivalingappa *et al.*, 2013, Akila and Jawaharlal, 2005) . It could be concluded from the present investigation that out of thirteen cultivars evaluated the cultivar Fanstasia and Calisto were found to be the best cultivars with superior in quality and quantity for cut flower production under Shevaroy condition of Eastern Ghat.

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Table 1. Performance of Anthurium cultivars under Shevaroy conditions - Growth attributes

Cultivars	Plant height (cm)	Plant spread (cm)	Number of leaves	Leaf length (cm)	Leaf breadth(cm)	Number of suckers
Acropolis	54.50	33.00	4.50	27.36	15.60	1.01
Angel	43.60	37.00	4.70	27.87	14.60	3.04
Calisto	66.00	67.25	5.00	33.54	20.50	2.73
Cheers	48.20	32.50	3.50	23.61	14.30	2.03
DO 32	41.50	33.50	3.00	27.87	14.80	2.30
Fantasia	59.50	73.20	5.00	30.50	25.50	2.03
Fire	49.50	40.50	4.50	25.33	14.90	2.13
Lumina	51.00	32.50	4.00	25.94	15.00	3.14
Marysia	24.00	19.00	4.50	25.74	13.40	2.03
Midori	31.47	28.40	4.50	21.73	24.47	2.37
Rosa	52.50	42.50	4.00	30.40	17.00	3.04
Titicaca	45.00	38.00	4.25	31.92	16.60	3.04
Xavia	49.00	24.00	4.00	29.90	18.20	2.03
SE.d	**2.87**	**2.57**	**0.07**	**1.36**	**2.20**	**0.13**
CD(p=0.05)	**5.92**	**5.31**	**0.42**	**2.81**	**4.54**	**0.26**

Table 2. Performance of Anthurium cultivars under Shevaroy conditions- Floral characters

Cultivars	Petiole length (cm)	Stalk length (cm)	Spathe length (cm)	Spathe width (cm)	Spadix length (cm)	No. of spikes per plant
Acropolis	22.00	18.50	7.40	7.00	5.88	3.00
Angel	29.20	18.00	7.20	6.90	5.98	2.00
Calisto	37.00	41.00	12.67	10.20	6.08	8.00
Cheers	20.00	30.00	7.09	6.50	4.36	3.00
DO 32	23.00	25.00	11.15	8.00	4.56	3.00
Fantasia	33.00	38.00	12.67	13.50	6.59	7.00
Fire	25.50	33.00	10.13	9.50	5.07	3.00
Lumina	20.00	33.00	12.67	6.50	5.58	4.00
Marysia	19.00	23.00	6.08	5.00	4.05	2.00
Midori	21.00	27.67	8.12	7.34	6.30	2.67
Rosa	27.00	25.00	10.13	10.50	5.58	5.00
Titicaca	22.00	18.00	8.31	7.50	4.56	5.00
Xavia	30.00	38.00	8.62	8.10	5.37	6.00
SE.d	**1.36**	**1.36**	**0.58**	**0.59**	**0.51**	**0.20**
CD(p=0.05)	**2.81**	**2.81**	**1.21**	**1.22**	**1.05**	**0.42**

Table 3. Morphological traits of anthurium cultivars based on the spathe and spadix color

Anthurium cultivars	Spathe colour	Spadix colour
Acropolis	Pure white	Creamish yellow
Angel	White	Whitish and greenish tinge
Calisto	Red	Whitish and greenish tinge at the tip of spadix
Cheers	Pink	Peach variety with green spadix
DO 32	Deep orange	Creamish yellow
Fantasia	Greenish	Greenish spadix
Fire	Red	Creamish yellow
Lumina	Pale Whitish with margins	Violet
Marysia	Creamish Yellow	Whitish and greenish tinge at the tip of spadix
Midori	Green	greenish
Rosa	Whitish pink	Pinkish with yellowish tinge at the tip of Spadix
Titicaca	White and green at the margins	Greenish spadix
Xavia	Red	Red

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Table 4. Genotypic and Phenotypic correlation coefficient for different characters in Anthurium

Characters		Plant spread	No. of leaves	Leaf length (cm)	Leaf breadth (cm)	No. of suckers	Petiole length (cm)	Stalk length (cm)	Spathe length (cm)	Spathe width (cm)	Spadix length (cm)	No of spikes per plant
Plant height (cm)	G	0.759**	0.235	0.625*	0.241	-0.003	0.670*	0.490	0.639*	0.650*	0.469	0.747**
	P	0.775**	0.260	0.597*	0.302	0.079	0.703**	0.535	0.670*	0.689**	0.539	0.730**
Plant spread	G	1.000	0.507	0.620*	0.597*	0.124	0.750**	0.470	0.680*	0.862**	0.585*	0.740**
	P	1.000	0.515	0.569*	0.559*	0.180	0.777**	0.516	0.710**	0.864**	0.577*	0.739**
No. of leaves	G		1.000	0.252	0.525	-0.035	0.504	0.165	0.064	0.342	0.687**	0.321
	P		1.000	0.280	0.431	-0.003	0.518	0.195	0.091	0.360	0.536	0.330
Leaf length (cm)	G			1.000	0.249	0.275	0.717**	0.167	0.450	0.569*	0.189	0.819**
	P			1.000	0.059	0.280	0.700**	0.215	0.410	0.489	0.200	0.719**
Leaf breadth (cm)	G				1.000	-0.077	0.514	0.489	0.383	0.649*	0.717**	0.600*
	P				1.000	0.045	0.465	0.480	0.420	0.659*	0.750**	0.525
No. of suckers	G					1.000	0.121	-0.039	0.303	0.025	-0.040	0.167
	P					1.000	0.187	0.031	0.355	0.097	0.150	0.189
Petiole length (cm)	G						1.000	0.547	0.501	0.743**	0.609*	0.759**
	P						1.000	0.589*	0.529	0.747**	0.592*	0.760**
Stalk length (cm)	G							1.000	0.644*	0.529	0.277	0.687**
	P							1.000	0.670*	0.550	0.388	0.682*
Spathe length (cm)	G								1.000	0.670*	0.407	0.665
	P								1.000	0.700**	0.475	0.667
Spathe width (cm)	G									1.000	0.565*	0.720
	P									1.000	0.590*	0.725
Spadix length (cm)	G										1.000	0.450
	P										1.000	0.395

*, ** Significant at 5 % and 1 % level respectively

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Table 5. Path coefficient analysis for different characters in Anthurium

Traits	Plant height (cm)	Plant spread	No. of leaves	Leaf length (cm)	Leaf breadth (cm)	No. of suckers	Petiole length (cm)	Stalk length (cm)	Spathe length (cm)	Spathe width (cm)	Spadix length (cm)	No. of spikes per plant
Plant height (cm)	**0.850**	-0.460	0.065	0.107	0.218	-0.001	0.209	-0.058	0.210	-0.069	-0.330	**0.850**
Plant spread	0.638	**-0.620**	0.129	0.105	0.557	0.015	0.250	-0.049	0.225	-0.089	-0.409	**-0.620**
No. of leaves	0.201	-0.321	**0.260**	0.039	0.492	-0.005	0.160	-0.018	0.018	-0.034	-0.489	**0.260**
Leaf length (cm)	0.540	-0.389	0.069	**0.177**	0.235	0.030	0.235	-0.019	0.147	-0.059	-0.135	**0.177**
Leaf breadth (cm)	0.209	-0.380	0.140	0.039	**0.925**	-0.008	0.169	-0.050	0.120	-0.071	-0.510	**0.925**
No. of suckers	-0.002	-0.077	-0.007	0.045	-0.081	**0.110**	0.041	0.002	0.095	-0.004	0.030	**0.110**
Petiole length (cm)	0.565	-0.475	0.129	0.121	0.468	0.015	**0.330**	-0.051	0.165	-0.077	-0.435	**0.330**
Stalk length (cm)	0.430	-0.299	0.042	0.031	0.456	-0.006	0.181	**-0.101**	0.206	-0.054	-0.199	**-0.101**
Spathe length (cm)	0.560	-0.431	0.019	0.080	0.357	0.034	0.165	-0.061	**0.310**	-0.069	-0.280	**0.310**
Spathe width (cm)	0.565	-0.536	0.089	0.100	0.610	0.001	0.239	-0.049	0.210	**-0.107**	-0.401	**-0.107**
Spadix length (cm)	0.418	-0.362	0.179	0.034	0.670	-0.003	0.199	-0.025	0.129	-0.062	**-0.715**	**-0.715**

Residual effect =0.35

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Table 6. Effect of holding solutions on the keeping quality of Cut - Anthurium

Cultivars	$Al_2(SO_4)_3$. $16H_2O$ - 300 ppm	$Al_2(SO_4)_3$. $16H_2O$ - 300 ppm + Kinetin - 25 ppm	Sucrose 5% + $Al_2(SO_4)_3$, $16H_2O$ – 300 ppm	Sucrose 5% + Kinetin – 25 ppm	Sucrose 5% + $Al_2(SO_4)_3$, $16H_2O$ – 300 ppm + Kinetin – 25 ppm	Control (Double distilled water)
Acropolis	20.00	22.00	23.00	24.00	24.00	12.00
Angel	19.00	21.00	24.00	25.00	26.00	13.00
Calisto	24.00	26.00	27.00	27.00	29.00	14.00
Cheers	17.00	19.00	21.00	22.00	23.00	12.00
DO 32	19.00	21.00	23.00	24.00	25.00	14.00
Fantasia	23.00	25.00	26.00	26.00	28.00	15.00
Fire	19.00	21.00	22.00	23.00	24.00	11.00
Lumina	18.00	19.00	21.00	21.00	23.00	12.00
Marysia	21.00	22.00	23.00	24.00	25.00	10.00
Midori	18.00	20.00	21.00	22.00	23.00	11.00
Rosa	17.00	21.00	23.00	24.00	25.00	15.00
Titicaca	21.00	24.00	25.00	27.00	27.00	16.00
Xavia	20.00	20.00	21.00	22.00	24.00	13.00
SE.d	**0.75**	**0.937**	**0.99**	**0.83**	**1.07**	**0.56**
CD(p=0.05)	**1.564**	**1.934**	**2.05**	**1.72**	**2.22**	**1.16**