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Productivity and quality of *Anthurium andreanum* influenced with growing conditions and fertilizers

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Abstract
An experiment was carried out to study the productivity and flower quality of *Anthurium andreanum* cv. Evita cultivated in shade house (75% shade net) and under natural forest trees at Herbal garden, School of Earth Sciences & Natural Resources, Management, Mizoram University, Tanhril, Mizoram. There were six different nutrient sources as F_0- control (no additional nutrient source); F_1- NPK (19:19:19) @ 25 g/pot/year; F_2- Biofertilizers (azospirillum and phosphotika) each @ 3 g/pot/year; F_3- Cattle manure @ 1.0 kg/pot/year; F_4- Pig manure @1.0 kg/pot/year and F_5- Poultry manure @ 0.5 kg/pot/year were applied in three equal splits. The experiment was laid out in Randomized Block design with factorial concept comprising in three replications. All vegetative and flowering parameters differ significantly at 0.05 level, and were observed better under Shade house (75% shade net) condition. Number of suckers per pot (4.77), number of leaves (23.73), leaf area (257.79cm^2), flower stalk length (41.68cm), flower stalk diameter (5.95mm), spadix length (60.77cm), spadix diameter (10.02mm), spathe area (103.25cm^2), vase life (19.67days) and number of flower per plant (3.57) were found maximum in F_1- NPK (19:19:19) @ 25 g/pot/year. Hence *Anthurium andreanum* cv. Evita planted in cocopeat, charcoal and vermicompost in the proportion of 6.5:1:1 placed under shade house (75% shade net) and fertilized with NPK (19:19:19) @ 25 g/pot/year can enhance growth and flowering characters.

Keywords: Anthurium, Flower quality, Natural forest trees, Potting nutrients, Shade house

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INTRODUCTION

The anthurium is a unique ornamental plant that stands out among most of the tropical cultivated flowers for its exquisiteness, durability and long vase-life. Anthurium belongs to the family Araceae, and is an evergreen, tropical herbaceous plant. It is a shade plant and therefore, have to be protected against too much direct light, radiation and wind (van der Leeden, 2001). It is also an interesting crop for agroforestry under dense canopies. In high rainfall areas, floriculture with anthurium under trees is highly profitable and provides a good permanent groundcover which effectively controls erosion (Anonymous, 1991).
Anthurium attract vast majority of growers for its massive effect, elegance and variety of colors, and consequently need to standardize the growing techniques (Islam *et al*., 2013). According to Chang *et al*., (2010), organic fertilizers such as pea and rice hull compost (PRHC) can replace the chemical fertilization management system for the cut flower production of *Anthurium andreanum* cultivated under soilless conditions. It is important to get cultivation techniques that are low in investment and yet increased yield. At the same time, anthurium being an export earning flower, it is necessary to produce good quality flower that are marketable in the local as well as the export market. A study is thus made to compare the effects of anthurium cultivation under natural shade of trees with shade house, on the flower yield and various flower quality parameters.

MATERIALS AND METHODS

A. andreanum plants were cultivated in Herbal garden, School of Earth Sciences and Natural Resources, Management, Mizoram University, Tanhril, Mizoram. Cultivation was done on flower

beds laid out inside shade house, and also under natural forest trees. A soilless media was prepared by mixing cocopeat, charcoal and vermicompost in the proportion of 6.5:1:1 filled plastic pot (25 cm width and 21 cm height with 10.3 litre volume) used for planting of tissue culture plantlets of anthurium cv. Evita (AVO Anthurium Vogels, Holland). The nutrients from the different sources were applied thrice in a year at four month interval.

Two kinds of growing conditions, one was of inside shade house of 75% shade net and Tree shade (plants cultivated under the shade of natural forest trees). The other treatment was that for nutrient sources. The different sources of nutrient were applied F_0 - control (no additional nutrient source); F_1 - NPK (19:19:19) @ 25 g/pot/year; F_2 - Biofertilizers (azospirillum and phosphotika) each @ 3 g/pot/year; F_3 - Cattle manure @ 1.0 kg/pot/year; F_4- Pig manure @1.0 kg/pot/year and F_5- Poultry manure @ 0.5 kg/pot/year.

The experimental design being adopted may be considered as Randomized Block design with factorial concept comprising in three replications. Each treatment represents an individual 12 pots with a single treatment each and 3 randomly selected pots were taken for recording the observations.

Flowers produced were harvested and their number recorded regularly, and their sum was obtained and analysis was taken for a year, and was recorded as the number of flowers per plant per year of that plot. A representative sample flower from each treatment was taken as one time observation, and subjected for several analysis like leaf area, stalk length and diameter; spadix length and diameter; spathe area and vase life (days) of the cut flower while No. of leaf and No. of suckers per plant were recorded at the end of an experiment.

Representative sample of leaf and spathe were measured in a leaf area meter (Systronics leaf area meter 211). A relationship between linear measurements and spathe area was established (Dufour and Guerin, 2003). The equation was:

Area (cm^2) = 0.94 x length (cm) x breadth (cm) Eq.1

With a coefficients of determination R^2 = 0.96. The total area, calculated with the equation was analyzed.

To examine the relationship between each of the flower quality parameters, correlation between each of the parameters, like between stalk length and stalk diameter, spadix length and spathe area etc, are calculated and presented in table form (Table 2).

RESULTS AND DISCUSSION

Vegetative parameters: In current investigation, it was observed that number of suckers per plant, number of leaves, leaf area (cm^2) of Anthurium were significantly influenced at 0.05 level by growing conditions (Table-1). Anthurium placed under Shade house (75% shade net) condition observed better significantly at 0.05 level in case of all vegetative parameters. In case of different potting nutrients, treatment F_1 - NPK (19:19:19) @ 25 g/pot/year was found superior in all vegetative parameters. Number of suckers per plant and leaf area was found statistically at par with treatment F_5- Poultry manure @ 0.5 kg/pot/year while number of leaves per plant were on the same bar of F_5 F_4 and F_2. Uikey *et al.* (2015) from their study on pea (*Pisum sativum*), concluded that combination of organic manure, bio-fertilizer and inorganic fertilizers were important to improve the growth and yield attributing characters. Sangeetha *et al.,* (2012) also opined that combined application of chemical fertilizers and organic manures have synergistic effects in periwinkle (*Catharanthus roseus* L.) production.

Number of flowers: Flower production varied significantly at 0.05 level under shade house and tree shade conditions (Table 1). The average number of flowers produced per plant per year during experiment under shade house was 3.54, which was much higher than those under tree shade (1.72). The effects of environmental conditions such as cultivation conditions and seasons are apparent in the number of flowers produced by anthurium plants. Dufour and Guerin (2003) also discussed that the number of flowers produced may decrease during certain months such as February, April and November in their experiment with anthurium cultivation, but these variations are not related to temperature. Chang *et al*. (2012) showed that regardless of nutrient treatment, the climate in the spring and summer (April–October) of their study was beneficial for *A* growth and flower yield as a result of the higher air temperature and *PAR* than in the fall and winter (October–April).

Anthurium fertilized with NPK (19:19:19) @ 25 g/pot/year treatment resulted in the highest number of flowers per plant per year with 3.57, this was followed by poultry manure treatment (2.83) and pig manure treatment (2.60), however the lowest flower number (2.03) was noted under control treatment. Canover and Henny (1995) observed that proper fertilizer dose and source to plant can enhance anthurium flower yield, and for this they suggest use of 900-1200 lb N/A/yr from a 1-1-1ratio fertilizer such as a liquid 20-20-20 or slow release 14-14-14 Osmocote. Uikey *et al.* (2015) from their study on *Pisum sativum*, concluded that combination of organic and inorganic fertilizers were important to quality flower production. According to Mohanty *et al.* (2015) application of organic inputs in combination with chemical fertilizers (50% vermicompost + 50% NPK) was found better option than application of organic manure or

Table 1. Influence of growing conditions and fertilizer on vegetative and flowering characters of anthurium cv. Evita.

Treatments	No. of suckers per plant	No. of leaves	Leaf area (cm^2)	Flower Stalk length (cm)	Flower Stalk diameter (mm)	Spadix length (mm)	Spadix diameter (mm)	Spathe area (cm^2)	Vase life (Days)	No. of flower per plant
Growing Conditions										
G_1 : 75% Shade net	5.41	25.93	261.83	43.90	6.76	68.20	10.68	105.00	19.28	3.54
G_2 : Under tree shade	3.06	16.30	156.66	26.80	3.88	45.87	7.64	62.95	12.59	1.72
S.Em. ±	0.08	0.59	7.05	1.15	0.15	1.09	0.21	2.90	0.40	0.09
CD@5%	0.25	1.73	20.67	3.38	0.43	3.20	0.62	8.51	1.18	0.26
Potting Fertilizers										
F_0	3.70	17.77	166.35	27.48	4.54	51.61	8.08	66.41	12.28	2.03
F_1	4.77	23.73	257.79	41.68	5.95	60.77	10.02	103.25	19.67	3.57
F_2	4.13	21.13	196.73	35.62	5.24	57.77	9.15	78.89	14.83	2.43
F_3	4.00	20.04	192.31	28.32	5.15	54.72	8.69	78.26	13.83	2.33
F_4	4.32	21.70	215.42	36.62	5.47	57.82	9.37	86.24	16.72	2.60
F_5	4.47	22.33	226.85	37.01	5.55	58.54	9.64	90.81	18.28	2.83
S.Em. ±	0.15	1.02	12.21	2.00	0.26	1.89	0.37	5.03	0.70	0.16
CD@5%	0.43	2.99	35.81	5.85	0.75	5.54	1.08	14.74	2.05	0.46
Interaction effect (GXF)										
S.Em. ±	0.21	1.44	17.27	2.82	0.36	2.67	0.52	7.11	0.99	0.22
CD@5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cv %	8.45	11.82	14.29	14.44	11.80	8.12	9.81	14.66	10.73	14.53

F_0 Control (no additional nutrient source)
F_1 NPK (19:19:19) @ 30 g/pot/year
F_2 Biofertilizers (azospirillum and phosphotika) @ 3 g/pot/year
Nutrient was applied in three equal splits during a year
F_3 Cattle manure @ 1kg /pot/year
F_4 Pig manure @ 1kg /pot/year
F_5 Poultry manure @ 0.5kg /pot/year

Table 2. Correlation between different parameters of anthurium flower quality.

	Stalk length	Stalk Diameter	Spadix length	Spadix diameter	Spathe area	Vase life
Stalk length	1.00					
Stalk Diameter	0.752**	1.00				
Spadix length	0.689**	0.901**	1.00			
Spadix diameter	0.716**	0.917**	0.930**	1.00		
Spathe area	0.564**	0.820**	0.831**	0.774**	1.00	
Vase life	0.510**	0.567**	0.592**	0.472**	0.692**	1.00

** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed)

biofertilizer alone for the growth and yield of onion (*Allium cepai* L.)

Flower quality parameters: Observation on different parameters of flower quality was made. Detail morphological characters and vase life under shade conditions and various treatments are presented in table-1. Results reveal that longest stalk length (43.90 cm), stalk diameter (6.76 cm), Spadix length (68.20 mm) and spadix diameter (10.68 mm) were obtained under shade house while the least results were noted under tree shade. Moreover, larger spathe area (105.00 cm^2) was obtained under shade house, which was much higher than those under tree shade (62.95 cm^2). Agasimani *et al.* (2011) also observed difference in spathe length and spathe breadth with the effect of difference in growing conditions for *A. andreanum* flowers. Flower quality of *A. andreanum* is also affected by environmental factors such as light and temperature (Nirmala *et al.,* 1999) and Hatibarua *et al.* (2005).

The longest stalk length (41.68 cm), stalk diameter (5.95 cm), Spadix length (60.77 mm) and spadix diameter (10.02 mm) were significantly higher with NPK treatment compared to other treatments, which was statistically at par with poultry manure, pig manure and bio-fertilizers treatments. In case of spathe area, treatment F_1 - NPK (19:19:19) @ 25 g/pot/year have largest spathe area (103.25cm^2) which was on the same bar of F_5, while the lowest spathe area was observed in control (66.41 cm^2). Supply of NPK may have enhanced the nitrogen and carbohydrate metabolism resulting in greater stalk lengths (Ahmed, 2006) and other quality characters too.

The flowers were kept in vase solution containing pure water and were observed for their vase life. Observations reveal that flowers obtained from under tree shade have a comparatively shorter vase life compared to flowers from plants grown under shade house. Flowers grown under shade house condition retain fresh longer with significantly maximum vase life (19.28 days) as compared to those grown under forest tree shade (12.59 days). This might be due to favourable surrounding environment that leads to better plant performance which is responsible for longer vase life. Similar trend was observed by Femina *et al.* (2006) with diversified polyhouse structures.

Anthurium fertilized with NPK had maximum vase life (19.67 days) which was statistically on the same bar with poultry manure treatment (18.28 days). However, the least vase life (12.28 days) was noted in control treatment. According to Waheeduzzama *et al*., (2006), the addition of NPK or organic manures result in slow and steady release of nutrient and moisture to the plant that assist in maintenance of turgor in the leaf and flower which favourably extended the vase life of *A. andreanum* flower.

The correlation table (Table 2) revealed that there was significant effect between different parameters of flower quality observed during the experiment. There was a positive correlation between stalk length with stalk diameter (0.752), spadix length (0.689), spadix diameter (0.716), spathe area (0.564), and vase life (0.510), and these correlations are highly significant (P= 0.01). Also stalk diameter have positive correlation with spadix length (0.901), spadix diameter (0.917), spathe area (0.820) and vase life (0.567); spadix length again has positive correlation with spadix diameter (0.930) and spathe area (0.831) and vase life (0.592); spadix diameter has a significant positive correlation with spathe area (0.774) and vase life (0.472) at 0.01 level of significance. There is a positive correlation between vase life and spathe area (0.692) at 0.01 level of significance.

Conclusion

Tissue culture plantlets of *A. andreanum* cv. Evita planted in cocopeat, charcoal and vermicompost in the proportion of 6.5:1:1 filled plastic pot placed under shade house (75% shade net) and fertilized with NPK (19:19:19) @ 25 g/pot/year can enhance growth and flowering characters.

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