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Growth and flowering response of flamingo flower on selected growth media

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Abstract

Conventional vegetative propagation of flamingo flower (*Anthurium andraeanum* Lind.) is time consuming while commercial quantities can take years to develop. Hence, determination of a suitable and available potting media/ potting media mixes to provide solution to its propagation and flowering challenge is imperative. The growth response and sustainability of flamingo flower in different growth media were evaluated under nursery conditions between late planting season of 2011 (September) to early planting season of 2012 (February). Second planting was during the early planting season (June) to late planting season of 2012 (December) in the screen house of the National Horticultural Research Institute, Ibadan, Oyo State, Nigeria. Eight growth media *viz.* topsoil alone (TS) (control), topsoil + poultry manure (TSP) 3:1, sawdust + poultry manure (SP) 3:1, river sand + poultry manure (RSP) 3:1, coconut husk + poultry manure (CHP) 3:1, coconut coir + poultry manure (CcP) 3:1, maize cob + poultry manure (MCP) 3:1, oil palm empty fruit bunch + poultry manure (EFBP) 3:1 were tested. Suckers of *Anthurium* were planted in nursery bags arranged in a Completely Randomized Design with three (3) replicates in each planting year. Results indicated that growth media significantly affected the percentage of surviving plants. Sawdust + poultry manure (SP) (3:1) (93.33 %) was similar to those in coconut coir + poultry manure (CcP) (3:1) (80.00 %). Plants in the medium, coconut coir + poultry manure (CcP) (3:1) (7.33) were the better as compared to all the others in both planting years in terms of visual quality at 85 days after planting (85 DAP). Flower production in *Anthurium* was not significantly affected by growth media utilised in this study.

Key words: Agricultural waste, *Anthurium andraeanum* Lind., flowering, growth, potting media, production

Introduction

Flamingo flower *(Anthurium andraeanum* Lind.) is a perennial, herbaceous plant that is highly valued for its colourful and attractive flowers and exotic foliage. It belongs to the family Araceae and there are about 1500 tropical ornamental *Anthurium* species (Gantait *et al*., 2008). It is also one of the most important of the tropical cut flowers (Galinsky and Laws, 1996). It is also called as Oil cloth flower, Tail flower, Painter's palette, Flamingo lily; Flamingo flower or Boy flower, both referring to the structure of the spathe and the spadix (Gilman, 2014). It is native to Central and South America. *A. andraeanum* is commercially exploited extensively as cut flower primarily because of its long vase life and as potted plant. Propagation of this flower is both by seeds (Dufour and Guerin, 2003) and by vegetative means (cuttings and suckers) (Çimen and Özge, 2009). To grow well, it requires a medium that has ample porosity (to provide sufficient space for root growth and good gas exchange), a low salt content, and a slightly acidic pH (Anon, 2002). They prefer a coarse and well-drained media. Cinders (red or black), coconut husks, fern logs, peat moss, and perlite are media components used by local growers (Kauai Nursery & Landscaping, Inc., 2011). Also used are forest litter, sugarcane bagasse, wood chips, coconut fiber, superficial layer of forest areas, leaf humus (Henny, 1999); fresh or composted pine bark (Stancato and Silveira, 2010); sand, and coir dust (Umaharan and Elibox, 2011); mixture of rough sand, composted cow manure (1:1:1) (Loges *et al*., 2004).

Conventional vegetative propagation of flamingo flower is time consuming and commercial quantities can take years to develop (Martin *et al*., 2003) resulting low availability of the desirable variety. Therefore, there is need to find a less time-consuming method of multiplication of the plant in order to provide solution to this challenge. Also, flowering in *A. andraeanum* takes about an average of a year (Chang *et al*., 2010; Linna *et al*., 2013). It is also considered to be a slow growing plant (Gilman, 2014). The length of time for its growth, development and flowering could be reduced by determining suitable growth media to ensure early establishment of suckers or terminal cuttings and improved growth rate and flowering.

Materials and methods

The experimental site was the screen house of the National Horticultural Research Institute, Ibadan, Oyo State, Nigeria (3^0 52'E and 7^0 25'N). One sucker each of *A. andraeanum* was planted in medium sized (10cm by 12cm) black polythene nursery bags filled with different growth media. The growth media used include: topsoil alone (TS), sawdust + poultry manure (SP) 3:1, river sand + poultry manure (RSP) 3:1, coconut husk + poultry manure (CHP) 3:1, maize cob + poultry manure (MCP) 3:1, oil palm empty fruit bunch + poultry manure (EFBP) 3:1. Based on observations recorded in the first year of this study, at second planting, topsoil + poultry manure, was included as a growth medium, growth media coconut coir was used in place of coconut husk; maize cob and oil palm empty fruit bunch were shredded into almost fine particles, with each medium having poultry

manure. Sawdust + poultry manure (SP) 3:1 and river sand + poultry manure (RSP) 3:1 were still used as media and topsoil alone was maintained as control.

The experiment was laid out in a Completely Randomized Design (CRD) with three (3) replicates in each planting year. The investigation was conducted during the late planting season of 2011 (September) to early planting season of 2012 (February). Second planting was done during the early planting season (June) to late planting season of 2012 (December). Topsoil was obtained from within NIHORT and sawdust from the Wood processing department of the Forestry Research Institute (FRIN), Ibadan, Oyo State. The trees lumbered were matured (>20 years). Cured poultry manure from poultry birds raised in battery cages. An equal amount of water (400 mL per week) was applied to each plant throughout the course of the experiment. Nursery and other cultural practices were carried out as at when the need arises. There was no insecticide application.

Data collection: Data was collected fortnightly on the following growth parameters: number of surviving plants expressed as:

$$\text{Plant survival (\%)} = \frac{\text{Total number of surviving plants}}{\text{Total number of plants}} \times 100,$$

number of leaves/plant, days to first flowering, number of flowers and visual quality at 85 days after planting. Visual quality was estimated giving scores from 1 to 10 based on quality (1 stands for the least and 10 for the best quality respectively on a self-determined marking and grading scheme (Yapa *et al*., 2000). It was determined using non parametric observations considering the entire plant and not a dependence on a particular character. Soil and media analyses were performed prior the experiment by standard procedure (IITA, 1979).

Data were subjected to analysis of variance (ANOVA) using SAS. Significant means were separated using Least Significant Difference (LSD) at 5 % probability level ($P< 0.05$) to compare the treatment means (SAS, 2012).

Analysis

Physical and chemical characterstics of the topsoil and media components utilised for this study are presented in Table 1.

Soil analysis: The topsoil was sandy loam in texture having particle size 58.4 % sand, 12 % clay and 29.6 % silt with pH 7.7.

Media analysis: The result indicated the difference in nutrient composition of the materials used in all the growth media. The media components were in three parts to one part of poultry manure (3:1) for each of the growth medium utilised in this study. Oil palm empty fruit bunch (EFB) contained the highest concentration of available nitrogen, N (0.65 %) followed by maize cob (0.55 %) while sawdust and river sand had the lowest N (0.1, 0.2) % and P (0.01, 0.02) % respectively. EFB had the highest P content (0.04 %), all others (media components) had similar available P. The highest available K was in EFB (1.4 %) closely followed by coconut husk (1.12).

Results

Percentage plant survival of *A. andraeanum* in selected growth media: Percentage survival of *A. andraeanum* was significantly affected by the media used. Percentage plant survival was highest in MCP at first planting up till 10 WAP, similar to plants in TS alone but this percentage was reducing over time while TP maintained its status till the end of the study (Table 2). At 10 WAP (first planting), a significantly lower survival percentage was observed in the medium CHP which was equivalent to 73.33 % (Table 2).

During second year of planting, at 4 WAP, 100 % survival was observed in *A. andraeanum* plants in the media SP, RSP and CcP. At 12-14 WAP, SP, EFBP and CcP having high percentage of plants survival compared with the other growth media (Table 2). Furthermore, at 18 WAP, there was significant percentage survival of plants in the media SP (93.33 %) till the termination of the study. Percentage survival of plants in SP (93.33 %) was similar with those in CcP (80.00 %), (not so at first planting as coconut husk were used). *Anthurium* plants survival in these media were significantly higher as compared with the other growth media (Table 2).

Percentage survival was the least in TP (3:1) throughout the second planting. Topsoil alone (TS) on the other hand had 60.00 - 73.33 % survival and support for the plants at both plantings (Table 2).

Leaf production in *A. andraeanum* in selected growth media: Plants grown in RSP produced the highest number of leaves throughout the duration of the study during second planting (Table 3). There was no significant difference in the number of leaves produced by the *Anthurium* plants in all the media at first planting. Plants in SP had the least number of leaves during both plantings.

Visual quality of *A. andraeanum* plants in selected growth media at 85 DAP: There was significant difference in the visual quality of the plants in the various media in the second planting year but not so in the first planting year (Table 4). At second planting, visual quality of *Anthurium* plants in the medium CcP (7.33) was the best compared to all the others in both years.

Table 1. Physical and chemical analysis of topsoil and media components

	Available macronutrients (%)					Available micronutrients (mg kg^{-1})			
Growth media	N	P	Ca	Mg	K	Na	Fe	Zn	Mn
Topsoil	0.5	0.02	0.16	0.01	0.1	0.01	35	43.2	1320
Sawdust	0.1	0.01	0.17	0.06	0.27	0.04	170	56.5	1495
River sand	0.2	0.02	0.03	0.003	0.01	0.01	323	30.5	1435
Empty Fruit Bunch	0.65	0.04	0.54	0.36	1.4	1.35	210	31.9	58.3
Coconut husk	0.45	0.02	0.03	0.05	1.12	0.24	170	42.1	28.1
Maize cob	0.55	0.02	0.04	0.01	0.53	0.02	19.2	34.3	933
Poultry manure	1.05	0.02	0.33	0.13	0.07	0.07	1.4	2.4	294

Flowering in *A. andraeanum* in selected growth media: There was no significant difference in growth media influence on *Anthurium* flowering in both planting years (data not shown) as no flowering was initiated in any of the plants.

Discussion

Percentage plant survival *in A. andraeanum* as affected by growth media: Survival of a plant is an index of the rooting of the plant. If there is no rooting of a plant, the plant will surely not survive. The similarity in the support of the growth media in percentage survival of plants by SP (93.33 %), CcP (80.00 %), (not so at first planting as coconut husk was used), suggest the effect of porosity and higher surface area of media on *Anthurium* plants survival (Table 2).

SP maintained the highest percentage plant survival throughout the study though it declined at 8 WAP and picked up two weeks later in first planting. Despite this, percentage plant survival in this medium (SP) in both years of study was stable, progressive, relatively above average, and significantly supported higher plant survival compared to others (Table 2). The similarity in support

Table 2. Effect of growth media on percentage of survival of *A. andraeanum*

Treatments	Survival percentage (weeks after planting)										
2011	4	6	8	10	12	14	16	18	20	22	24
TS	80.00	73.33	60.00	60.00	60.00	60.00	53.33	53.33	60.00	53.33	60.00
SP	60.00	53.33	46.67	46.67a	53.33	53.33	53.33	60.00	53.33	53.33	46.67
RSP	66.67	60.00	53.33	53.33	53.33	53.33	46.67	46.67	46.67	46.67	46.67
EFBP	73.33	53.33	46.67	46.67	46.67	60.00	53.33	53.33	46.67	46.67	46.67
CHP	73.33	60.00	46.67	26.67	26.67	33.33	40.00	46.67	40.00	13.33	26.67
MCP	80.00	80.00	66.67	60.00	53.33	46.67	40.00	40.00	33.33	53.33	46.67
LSD	38.43	35.58	37.5	30.24	34.58	39.34	48.9	51.01	48.9	43.58	47.44
2012											
TS	100.00	86.67	80.00	73.33	73.33	73.33	73.33	73.33	73.33	66.67	73.33
TSP	80.00	80.00	60.00	53.33	46.67	46.67	60.00	46.67	40.00	40.00	40.00
SP	100.00	93.33	93.33	80.00	86.67	80.00	100.00	93.33	93.33	93.33	93.33
RSP	100.00	93.33	80.00	66.67	66.67	66.67	86.67	66.67	60.00	66.67	66.67
EFBP	93.33	86.67	86.67	73.33	86.67	80.00	80.00	40.33	66.67	66.67	66.67
CcP	100.00	86.67	80.00	86.67	80.00	80.00	86.67	80.00	73.33	73.33	80.00
MCP	93.33	100.00	80.00	73.33	73.33	73.33	73.33	66.67	66.67	66.67	66.67
LSD	17.09	21.62	25.35	37.44	32.43	33.32	30.57	43.03	34.18	39.71	34.18

TS: Topsoil Alone, SP: Sawdust+ Poultry manure (3:1), RSP: River sand + Poultry Manure (3:1), EFBP: Empty Fruit Bunch (Oil palm) + Poultry manure (3:1), CHP: Coconut Husk + Poultry Manure (3:1), MCP: Maize cob + Poultry manure, CcP: Coconut coir + Poultry manure (3:1).

Table 3. Effect of growth media on number of leaves of *A. andraeanum*

Treatments	Number of leaves (weeks after planting)										
2011	4	6	8	10	12	14	16	18	20	22	24
TS	1.38	1.40	1.58	1.67	1.67	1.89	2.31	2.31	2.50	1.67	2.81
SP	1.33	1.28	1.33	1.22	1.53	1.94	2.33	2.33	2.25	1.53	2.14
RSP	1.31	1.56	1.45	1.72	1.94	2.05	2.33	2.33	2.17	1.94	2.72
EFBP	1.00	1.11	1.22	1.11	1.28	1.33	1.75	1.75	2.25	1.28	2.33
CHP	1.31	1.36	1.44	2.33	2.17	2.33	1.58	1.58	1.75	2.16	2.50
MCP	1.57	1.55	1.63	1.58	1.75	1.75	2.33	2.33	2.56	1.75	2.33
LSD	0.67	0.84	0.87	1.42	1.48	1.63	1.73	1.73	1.85	1.48	2.51
2012											
TS	1.00	1.20	1.20	1.40	1.33	1.60	2.00	2.18	2.43	2.98	2.92
TSP	1.13	1.19	1.19	1.61	1.61	2.06	2.10	2.94	2.78	3.83	3.50
SP	1.20	1.13	1.33	1.64	1.53	1.80	1.67	2.15	2.30	2.22	2.30
RSP	1.33	1.40	1.58	2.11	2.22	2.43	2.60	3.22	3.45	3.50	3.89
EFBP	1.00	1.07	1.07	1.07	1.19	1.42	1.37	1.58	2.17	2.58	2.67
CcP	1.07	1.25	1.33	1.38	1.50	1.67	1.70	2.33	2.31	2.72	3.00
MCP	1.00	1.17	1.42	1.92	2.18	2.42	2.17	2.75	3.64	3.25	3.39
LSD	0.48	0.56	0.83	1.01	1.16	1.47	1.17	1.77	1.77	2.15	2.49

TS: Topsoil Alone, SP: Sawdust+ Poultry manure (3:1), RSP: River sand + Poultry Manure (3:1), EFBP: Empty Fruit Bunch (Oil palm) + Poultry manure (3:1), CHP: Coconut Husk + Poultry Manure (3:1), MCP: Maize cob + Poultry manure, CcP: Coconut coir + Poultry manure (3:1).

Table 4. Visual quality of *A. andraeanum* at 85DAP as affected by potting media in order of response to media

Treatment	Visual quality at 85 DAP	
	Rating	Index
2011		
RSP	6.67a	Moderately good
SP	6.33a	Fairly good
EFBP	5.67a	Fairly good
MCP	5.00a	Average
TS	4.67a	Fair
CHP	4.00a	Fair
LSD	2.57	
2012		
CcP	7.33a	Moderately good
TSP	6.67ab	Moderately good
SP	6.33ab	Fairly good
RSP	6.33ab	Fairly good
EFBP	6.00ab	Fairly good
TS	5.33b	Average
MCP	5.00b	Average
LSD	1.58	

Means with the same letters along the columns are not significantly different at $P< 0.05$.

TS: Topsoil alone, SP: Sawdust + Poultry manure (3:1), RSP: River sand + Poultry Manure (3:1), EFBP: Empty Fruit Bunch (Oil palm) + Poultry manure (3:1), CHP: Coconut Husk + Poultry Manure (3:1), MCP: Maize cob + Poultry manure, CcP: Coconut coir + Poultry Manure (3:1).

Rating: 1. Least, 2. Not so fair, 3.Very fair, 4. Fair, 5. Average, 6.Fairly good, 7.Moderately good, 8-Good, 9- Very good, 10- Best.

for *Anthurium* plants survival by these media SP and RSP in first planting, though slightly different in second planting, suggest the positive effect of the permeable and porous nature of the growth media components. These characteristics of the media components are essential in the plant's production as the roots need a lot of air to develop properly.

Reduction in plant survival in MCP from 10 WAP could be as a result of available sugars from the broken maize cobs to the plants at the early weeks of planting. This trend was observed in the second planting though plant survival was better (>60 %), most probably as a result of higher surface area of finely broken dried maize cobs compared to medium utilised at first planting.

Leaf production: Number of leaves produced in *Anthurium* plants as cut flower is very important in its growth, development and aesthetics as it adds to its aesthetic and economic value. However, the use of growth media had no significant effect on the number of leaves produced in first planting while significant differences were observed at 10 and 16 WAP in the second planting. Also, RSP produced a significantly higher number of leaves (2.11 and 2.60) and had a stable, positive and consistent support for leaf production in second planting (Table 3) compared to the other media. EFBP produced the least (1.07 and 1.37) for 10 and 16 WAP, respectively.

Visual quality at 85 DAP: At first planting, the appearance of plants grown in RSP (6.67), according to the rating index in this study compared to all the other media was good. This was closely followed by plants grown in SP (6.33). This could be as a result of the suitability of the media, However, *Anthurium* plants in the medium CcP observed in the second planting were significantly very good (7.33) compared to the plants in the CHP growth medium (4.00). Plants grown in TS alone closely followed by those in MCP (though further shredded) were average in appearance. It is of note that visual quality of the *Anthurium* plants at 85 DAP in TSP was better than TS alone at both plantings. The use of an additional source of nutrient most likely affected the plants.

Plant performance: Application of nitrogen, potassium and calcium will markedly improve the yield and quality of flowers. However, deficiencies of these nutrients will adversely affect the plant growth and developments. Insufficient levels of nitrogen and potassium are associated with lower flower yield, reduced stem length and smaller flowers (World Agriculture Group, 2011). No plant deficiency symptoms were observed in all the *Anthurium* plants in this study. All the media were organic materials that were relatively porous and ensured adequate passage of water, have nutrients and air which are essential for plant growth and development, particularly for *Anthurium*. This is so as this plant require growing medium that allows aeration and is permeable. According to Kambooh (1984), the organic matter content in a planting medium are known to have a profound effect on its biological, physical and chemical properties, hence the presence of poultry manure must have improved the organic matter and nutrient content of all the media. In the first planting year, topsoil alone (TS) supported the survival of *Anthurium* plants better than those in CHP. Broken coconut husk is recommended for its propagation however it was observed that it was not able to sustain the production of the plant in the nursery for a long time. This was also observed in the medium EFBP. In second planting CcP supported *Anthurium* plants survival, leaves production (though not very encouraging) throughout the study, and best visual quality at 85 DAP. This implies coconut coir to be preferable compared to broken coconut husk as growth medium for *Anthurium.* This could be as a result of more porous, permeable yet adequate water retention capability of the coir. It most likely encouraged rooting of the plants, as adequate aeration is needed for roots formation in this plant.

At first planting, survival and growth response of *Anthurium* in MCP was very high as that of plants in TSP within the first ten weeks after planting, but plants survival declined gradually till the termination of the study. Whereas, in second planting MCP performed similarly, except EFBP at 10-16 WAP in leaf production. These findings suggest that maize cob when broken down or pyrolysed has no effect on *A. andraeanum* production and growth. This was observed by Linna *et al.* (2013) using replacement media, containing a mixture of peat and pyrolysed biomass residues of pyrolysed corn cobs (PC), composted corn cobs (C), pyrolysed garden wastes (PG), and peat (P). They observed that growth, development and yield of *A. andraeanum* were similar whether the plants were grown in P+PC medium, P+PC+PG medium, or in pure peat (P, the control). Finding of Linna *et al.* (2013) are similar to our results with regard to shredded and dry maize cobs for Anthurium plants production. It also indicated that, pyrolysed organic wastes, which are otherwise an environmental problem, can be used to reduce the requirement for peat and provide another way to convert biomass residues into useful products in the soilless culture of *A. andraeanum*.

Media SP and CcP greatly and similarly supported high percentage of anthurium survival throughout the study. Exception was in TSP which least supported the *Anthurium* plants with average of 46.67 % at second planting, and 53.33 and 60 % in TS alone at first and second planting, respectively.

Flowering: None of the media used in this study reduced the time of first flowering as none of the plants flowered in both planting years. Anthuriums produce flowers throughout the year and average yield varies from 4.3 to 9.4 flowers per plant per year (Talia *et al*., 2003; Cuquel and Grossi, 2004; Singh *et al*., 2011). This means that a new flower appears every 39 to 84 days. However, it was observed that though the media had different concentration of nutrients, they did not affect flower yield. This was also observed in previous studies by Chang *et al*. (2010) and Linna *et al*. (2013). Their findings suggest that the nutrients supplied by all the media in their studies were adequate for producing quality flowers but such did not translate to significant differences in flower yields nor sizes. This characteristic of producing 4-9 flowers per plant per year may have played a role in the response to growing media type and fertilization (poultry manure) not having been immediate, especially since it was within six (6) months of cultivation.

From this study, either of CcP (3:1), SP (3:1), RSP (3:1) and EFBP (3:1) in this order could be used to produce *A. andraeanum* plant with high survival percentage, excellent growth and visual quality. All materials used in the media were permeable, accessible and affordable by the average commercial and individual florist.

Though MCP (3:1) may be used in *Anthurium* production, the dwindling support for survival should be put into consideration as well as the size of the shredded dried maize cobs. Also, EFBP (3:1), grounded oil palm empty fruit bunch performed better compared to broken ones. It is suggested that for improved *Anthurium* plants survival, growth and visual quality, a combination of the highly supportive media be used in its production. It is recommended that further studies aimed at speeding up flower production in flamingo flower using other agricultural waste be carried out.

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