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Effect of different growth media on the growth and flowering of beefsteak begonia (*Begonia erythrophylla*)

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Abstract

Experiments were conducted over a two-year cropping season to determine the effect of growth media on rooting, growth and flowering. Nine growth media *viz*., river sand (RS), topsoil + poultry manure (T+P), topsoil (T), river sand + poultry manure (RS+P), sawdust (S), topsoil + river sand + poultry manure (T+RS+P), topsoil + sawdust (T+S), sawdust + river sand (S+RS), topsoil + poultry manure + river sand + sawdust (T+P+RS+S) were used for the study. It was found that growth media significantly (P>0.05) affected the number of branches and branch length per plant; number of leaves and number of flowers per plant. The quantity of flowers produced per week varied according to each growth media as follows: Begonia planted in topsoil + poultry manure (4:1) produced the highest number of flowers per plant, while sawdust + river sand (3:1) produced the least number of branches per plant, branch length per plant, number of leaves per plant and number of flowers per plant in the two years of the experiment. The slow growth, poor development and late blooming in soil + sawdust (4:1) and sawdust + river sand (3:1), could be as a result of inadequate nutrients in the substrates. Topsoil + poultry manure (4:1) growth medium (with or without river sand), appeared to be the suitable growth medium that will significantly enhance early rooting, establishment, growth and development of beefsteak begonia and sustain flower production for a good length of time.

Key words: Flowers production, plant characters, responses, rooting, beefsteak begonia

Introduction

The genus *Begonia,* occuring in the tropics and sub-tropics of both hemispheres, belongs to the family, *Begoniaceae* (Henley *et al*., 2009). There are three main types of begonias: grown from tubers, rhizomes and fibrous roots. The fibrous type includes the wax begonia [semperflorens], the angel wings and all those with hairy leaves. Rex Begonias, grown from rhizomes, have spectacular green, red, pink and silver markings on their leaves. Tuberous begonias have the biggest and brightest flowers but they perform best when grown outdoors (Andrews, 2005). The beefsteak begonia (*Begonia erythrophylla*) has pink flowers on long stalks. The flowers of begonias do not last long when picked. They are at their best when the plants are used as house plants or are bedded outdoors. Propagation by stem cuttings (vegetative propagation) is the most commonly used method for propagation as also used for most ornamental plants. Rooting time varies, with the type of cutting material used, the species being rooted and the growth/environmental conditions. Ornamental plants generally, including begonia, require good environmental conditions (growth environment), for easy rooting, growth and development. Good medium is a basic requirement for producing healthy and thriving plants (Adams *et al*., 2003). Growth media are the materials similar to soil that physically support plants grown in them (Ekpo and Sita, 2010). However, composition and nutritional status of media (Khasa *et al.,* 2005; Carlie, 2008) is important to produce quality indoor plant. One of the most important criteria for successful rooting is a reliable rooting medium. The percentage of rooting and quality of root can, in many ways, be directly linked to the medium (Wojtusik *et al*., 1994; Olosunde and Fawusi, 2003). Soil mixes play important role in pot plant production. It also determines the nutritional status of the potting media to sustain better growth (Gabriels *et al*., 1986). Choosing the most suitable growing media for a successful plant production is very important in potted plant growth. It play three roles *viz*., to support plant in soil, to hold and provide water and nutrients and to enable plant roots to get sufficient amount of oxygen (Ingram *et al*., 2003). A convenient growing media should not only supply physical, chemical and biological characteristics required by plants but also provide the conditions for practical plant production (for example, easy to supply, suitable cost, easy processing, lightness and homogenous plant production) (Mathur and Voisin, 1996; Sahin *et al*., 2002; Ingram *et al*., 2003; Sahin and Anapali, 2006). Some organic materials required to amend some physical and chemical characteristics of growth media in ornamental plant production include: the use of organic manure, saw dust, peat, paper waste etc. (Cull, 1989; Shadanpour *et al* 2011; Aklibasinda *et al*., 2011). The quality of plants grown in containers, particularly house plants, is dependent on the physical and chemical components of the medium, the suitability of the growth environment and necessary agronomic practices (Lamont and O Connell, 1987).

Begonia plants grow well with fertilization (Henley *et al*., 2009). Fertilizers are expensive though recommended in begonia production. Also, growers should use the cleanest mixes they can obtain for begonia production (Henley *et al*., 2009). For sustainability of the environment, organic materials from municipal and industrial waste, as well as residues from agriculture, forestry, green areas, and livestock farming are strongly recommended for use as renewable resources that mitigate their negative impact on regional and global environmental degradation. For a sustainable solution, many countries have tried recycling nutrients and improving soil characteristics for both agricultural and horticultural purposes (Dede *et al.*, 2006). Nursery and greenhouse vegetable growers are always concerned about the availability and cost of materials used as substrates in their production systems (Brian, 2005). One sustainable solution for cleaner, safer, and more eco-efficient use of wastes is recycling agricultural waste (Dede *et al.*, 2006). Recent studies indicated the beneficial effects of nutrient rich wastes on both media properties and plant growth (Dede *et al.*, 2009). Therefore, this study seeks to determine the effect of growth media on the rooting, growth, establishment and flowering of beefsteak begonia and the medium most suitable for yield optimization and extended sustainable flowering. It also aims at determining the efficacy of the abundant and easily accessible natural resources and farm by-products (farm wastes) that could be utilized as components to provide the required natural fertilizers for the growth media for begonia propagation and production.

Materials and methods

Experiments were conducted in the screen house at the National Horticultural Research Institute, (NIHORT), Ibadan, Oyo State, Nigeria (3^{o} 52'E and 7^{o} 25'N) between July to October, 2009 and repeated in August to November, 2010. Cuttings of beefsteak Begonia of about 15 cm long, each with eight (8) nodes were planted in medium size (10 x 12 cm) perforated black polythene nursery bags filled with different growth media. One cutting was planted per nursery bag. Nine growth media were used. The growth media were: 1) RS; 2) T+P; 3) T; 4) RS+P; 5) S; 6) T+RS+P; 7) T+S; 8) S+RS; 9) T+P+RS+S. The experimental design was Completely Randomized Design (CRD) with three replications. Equal amount of water was applied to each plant throughout the course of the experiment. Nursery and other cultural practices were carried out. There was no insecticide application. Data were collected on plant plant height, number of leaves/plant, number of flowers/week and number of branches fortnightly from each plant. Data collected was subjected to one way Analysis of Variance (ANOVA) using SAS-GLM procedures (SAS Institute, 2000). The means were separated by the least significant difference (LSD $P < 0.05$).

Results

The different growing media for beefsteak begonia significantly affected the number of branches per plant, branch length, the number of leaves per plant and number of flowers per plant in the two seasons.

In the first planting, T+P (4:1) significantly supported the highest production of the number of branches per plant in beefsteak begonia throughout the course of the experiment (Table 1). However, T+RS+P (2:1:1); RS+P (3:1) and T alone, performed similar to T+P (4:1) from the 6th week to the 10th week of the experiment (Table 1). The media T+S (4:1) and S alone were the least supportive of the production of the number of branches of begonia.

At second planting, T+P (4:1) significantly supported the highest production of the number of branches of plant in beefsteak begonia throughout the course of the experiment (Table 1). However, there was no significant difference in its performance between this medium and T alone, T+RS+P (2:1:1), respectively from the 6th week to the 10th week of the experiment (Table 1). S+RS (3:1) least supported the production of the number of branches of begonia.

Table 1. Effect of growth media on the number of branches of beefsteak begonia

Treatment	Week after planting (WAP)				
	2	4	6	8	10
			2009		
RS	2.17^{ab}	2.20^{a}	2.10^{c}	1.83^{c}	1.90^{d}
T+P	2.63^{a}	2.23^{a}	3.93^{a}	4.67^{a}	4.03^{b}
T	2.60^{a}	2.27^{a}	3.07^{ab}	3.87^{ab}	3.20^{c}
RS+P	2.37^{ab}	2.00^{a}	3.93^{a}	3.67^{b}	3.97^{b}
S	1.93^{ab}	1.47^{a}	2.00^{c}	1.47^{c}	0.67^{e}
T+RS+P	2.33^{ab}	1.67^{a}	3.20^{ab}	4.27^{ab}	5.17^{a}
T+S	2.27^{ab}	1.93^{a}	1.93^{c}	1.93^{c}	1.13^{e}
S+RS	1.63^{b}	1.47^{a}	1.97^{c}	1.27^{c}	0.93^{e}
T+P+RS+S	1.83^{ab}	2.33^{a}	2.73^{bc}	4.70^{a}	2.03^{d}
			2010		
RS	0.00^{c}	0.75^{a}	1.85^{de}	3.15^{c}	3.30^{b}
T+P	0.10^{bc}	1.45^{a}	4.15^{a}	5.45^{a}	5.60^{a}
T	0.25^{b}	1.35^{a}	3.55^{ab}	4.55^{b}	4.75^{a}
RS+P	0.20^{bc}	1.45^{a}	2.45^{cde}	3.50^{c}	3.70^{b}
S	0.20^{bc}	0.75^{a}	1.80^{de}	2.90^{c}	2.95^{b}
T+RS+P	0.50^{a}	1.35^{a}	3.00^{bc}	5.13^{ab}	5.30^{a}
T+S	0.00^{c}	0.80^{a}	2.60^{cd}	3.55^{c}	3.65^{b}
S+RS	0.00^{c}	0.60^{a}	1.60^{e}	2.70^{c}	2.95^{b}
T+P+RS+S	0.20^{bc}	0.90^{a}	2.20^{cde}	3.25^{c}	3.50^{b}

Means with the same letters are not significantly different at $P<0.05$ along columns. RS = River sand, T+P = Topsoil + Poultry manure (4:1), T = Topsoil, RS+P = River sand + Poultry manure (3:1), S = Sawdust, T+RS+P = Topsoil + River sand + Poultry manure, (2:1:1), T+S = Topsoil + Sawdust (4:1), S+RS = Sawdust + River sand (3:1), T+P+RS+S = Topsoil + Poultry manure + River sand + Sawdust (2:1:1:1).

Table 2. Effect of growth media on the branch length (cm) of beefsteak begonia

Treatment	Week after planting (WAP)				
	2	4	6	8	10
			2009		
RS	0.70b	1.73^{c}	2.00^{ab}	1.43^{d}	3.10^{bc}
T+P	1.17^{ab}	3.33^{a}	2.50^{a}	6.10^{a}	5.87^{a}
T	1.57^{a}	3.27^{ab}	2.50^{a}	3.97^{b}	3.80^{bc}
RS+P	1.07^{ab}	1.77^{c}	1.73^{bc}	3.03^{c}	4.00^{b}
S	1.00^{b}	1.33^{c}	1.17^{cd}	1.03^{d}	1.40^{d}
T+RS+P	1.13^{ab}	3.73^{a}	1.10^{cd}	4.50^{b}	3.97^{b}
T+S	0.90^{b}	2.47^{abc}	1.13^{cd}	1.00^{d}	1.37^{d}
S+RS	1.17^{ab}	1.83^{bc}	0.83^{d}	0.97^{d}	0.63^{d}
T+P+RS+S	1.00^{b}	3.80^{a}	1.10^{cd}	1.53^{d}	2.90^{c}
			2010		
RS	0.00^{a}	0.00^{b}	1.99^{bcd}	7.11^{cd}	7.79^{d}
T+P	0.00^{a}	1.40^{ab}	3.52^{bc}	9.86^{ab}	12.90^{b}
T	0.00^{a}	2.35^{a}	5.02^{ab}	8.81^{bc}	9.93^{c}
RS+P	0.00^{a}	2.50^{a}	4.27^{abc}	5.94^{de}	7.12^{d}
S	0.00^{a}	1.30^{ab}	0.16^{d}	1.38^{f}	4.26^{e}
T+RS+P	0.00^{a}	2.60^{a}	6.96^{a}	11.41^{a}	15.36^{a}
T+S	0.00^{a}	1.90^{ab}	3.44^{bc}	4.91^{de}	5.80^{de}
S+RS	0.00^{a}	0.00^{b}	0.11^{d}	1.00^{f}	5.79^{de}
T+P+RS+S	0.00^{a}	2.60^{a}	1.48^{cd}	3.46^{ef}	7.59^{d}

Means with the same letters are not significantly different at $P<0.05$ along columns RS = River sand, T+P = Topsoil + Poultry manure (4:1), T = Topsoil, RS+P = River sand + Poultry manure (3:1), S = Sawdust, T+RS+P = Topsoil + River sand + Poultry manure, (2:1:1), T+S = Topsoil + Sawdust (4:1), S+RS = Sawdust + River sand (3:1), T+P+RS+S = Topsoil + Poultry manure + River sand + Sawdust (2:1:1:1).

Table 3. Effect of growth media on the number of leaves of beefsteak begonia

Treatment	Week after planting (WAP)								
	2	3	4	5	6	7	8	9	10
					2009				
RS	4.67^{ab}	5.87^{ab}	5.27^{c}	5.93^{bc}	7.27^{c}	7.13^{c}	8.13^{d}	8.07^{cd}	9.60^{c}
T+P	4.73^{ab}	5.40^{abcd}	7.40^{a}	7.40^{ab}	10.73^{a}	14.00^{a}	15.70^{a}	21.27^{a}	20.27^{b}
T	5.00^{a}	6.40^{a}	7.20^{a}	8.53^{a}	11.73^{a}	13.77^{a}	15.77^{a}	19.33^{a}	20.53^{b}
RS+P	3.23^{c}	4.33^{d}	6.20^{abc}	7.27^{ab}	9.73^{a}	13.53^{a}	13.07^{bc}	15.80^{b}	18.47^{b}
S	3.80^{abc}	5.33^{abcd}	5.00^{c}	5.00^{c}	4.77^{d}	5.20^{c}	5.43^{e}	6.23^{d}	5.53^{c}
T+RS+P	3.53^{bc}	4.73^{bcd}	6.67^{ab}	7.67^{a}	11.53^{a}	12.83^{a}	15.07^{ab}	21.00^{a}	31.17^{a}
T+S	4.13^{abc}	5.67^{abc}	5.67^{bc}	5.53^{c}	6.67^{cd}	6.57^{c}	6.87^{de}	7.43^{d}	7.40^{c}
S+RS	3.80^{abc}	4.80^{bcd}	5.00^{c}	5.07^{c}	5.07^{d}	5.13^{c}	5.27^{e}	5.57^{d}	5.27^{c}
T+P+RS+S	4.07^{abc}	4.53^{cd}	5.27^{c}	5.67^{c}	8.30^{bc}	9.90^{b}	10.93^{c}	10.93^{c}	15.57^{b}
					2010				
RS	4.15^{ab}	4.50^{ab}	4.40^{c}	4.80^{e}	7.05^{b}	9.50^{cd}	11.75^{d}	12.20^{c}	11.75^{bc}
T+P	5.80^{a}	6.70^{a}	8.10^{a}	11.80^{a}	12.75^{a}	17.18^{a}	26.85^{a}	26.70^{a}	23.85^{a}
T	5.20^{ab}	5.90^{ab}	7.75^{a}	8.60^{bcd}	10.80^{ab}	13.85^{abc}	23.50^{ab}	25.35^{a}	21.40^{a}
RS+P	4.65^{ab}	5.40^{ab}	8.00^{a}	11.20^{ab}	10.75^{ab}	11.30^{bcd}	15.65^{cd}	15.10^{bc}	13.45^{b}
S	3.73^{b}	4.95^{ab}	6.00^{b}	6.40^{cde}	7.15^{b}	8.45^{d}	9.50^{d}	9.60^{d}	8.85^{cd}
T+RS+P	5.30^{ab}	6.05^{ab}	6.15^{b}	9.20^{abc}	10.30^{ab}	14.80^{ab}	19.43^{cb}	21.80^{ab}	21.10^{a}
T+S	4.40^{ab}	4.70^{ab}	6.15^{b}	6.60^{cde}	7.20^{b}	7.75^{d}	11.05^{d}	9.93^{c}	8.15^{d}
S+RS	3.85^{ab}	4.35^{b}	5.40^{c}	6.20^{de}	7.45^{b}	7.90^{d}	9.95^{d}	10.05^{c}	6.25^{d}
T+P+RS+S	5.20^{ab}	5.40^{ab}	6.20^{b}	7.10^{cde}	8.35^{b}	8.75^{cd}	10.35^{c}	11.63^{c}	11.60^{bc}

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

RS = River sand, T+P = Topsoil + Poultry manure (4:1), T = Topsoil, RS+P = River sand + Poultry manure (3:1), S = Sawdust, T+RS+P = Topsoil + River sand + Poultry manure, (2:1:1), T+S = Topsoil + Sawdust (4:1), S+RS = Sawdust + River sand (3:1), T+P+RS+S = Topsoil + Poultry manure + River sand + Sawdust (2:1:1:1)

At first planting, from four (4) weeks after planting up till the tenth (10) week, there was significant difference in the response of the begonia plants grown in the different growth media in terms of their branch lengths. The medium T+RS+P (2:1:1) maintained the longest branch lengths of the beefsteak begonia plants throughout the course of the experiment. This was closely followed by the media T+P (4:1) and T alone. The growth media S+RS (3:1) and S alone, least supported branch length of the beefsteak begonia plants throughout the experiment. The medium, T+P (4:1) supported the longest branch lengths for begonia throughout the experiment at second planting, closely followed by T+RS+P (2:1:1). The media S alone, T+S (4:1) and S+RS (3:1) least supported the growth of the branch lengths of beefsteak begonia plants.

At first planting, T+RS+P (2:1:1) gave the highest number of leaves per plant (31.17) (Table 3) at the 10th week. This trend was manifested throughout the course of the experiment. However, the performance of T+P (4:1) (21.27, 20.27) and T alone (19.33, 20.53) at the 9th and 10th week were similar and not significantly different though next in performance to T+RS+P (2:1:1) in high number of leaves produced. S+RS (3:1), least supported leaves production. At second planting, T+P (4:1) and topsoil alone, at the 9th and 10th week were not significantly different in their leaves production though they both encouraged production of highest number of leaves per plant. This trend was regular between these two media as from the 6th week through to the termination of the experiment though it was so from the onset in T+P (4:1). T+RS+P (2:1:1) also supported production of high number of leaves per plant (21. 80, 21. 10) (Table 3) at the 9th and 10th week. T+S (4:1), S alone and S+RS (3:1) least supported leaves production per plant.

Number of flowers produced weekly by beefsteak begonia varied across the growth media (Table 4). This shows that there was significant growth media effect on the plants with respect to this character. In the first planting, at 7th to 10th week of planting, begonia planted in T+P (4:1) (8.23) (Table 4) was profuse and maintained the production of the highest number of flowers. This was closely followed by plants in the media, RS+P (3:1) and T alone. Flower production was relatively low throughout the course of the experiment in S+RS (3:1), and T+S (4:1) media, compared with the other growth media used.

Table 4. Effect of growth media on the number of flowers of Beefsteak begonia

Treatment	Week after planting (WAP)					
	7	8	9	10	11	12
			2009			
RS	1.57^{c}	1.60^{d}	1.30^{d}	3.90^{c}	1.93^{d}	1.33^{b}
T+P	5.97^{a}	11.80^{a}	6.17^{a}	8.23^{a}	4.00^{bcd}	3.20^{ab}
T	2.87^{bc}	4.20^{c}	3.17^{bc}	3.83^{c}	1.13^{d}	1.73^{ab}
RS+P	6.17^{a}	8.17^{b}	6.73^{a}	6.63^{ab}	6.13^{bc}	2.27^{ab}
S	2.13^{c}	2.67^{cd}	2.33^{bcd}	3.27^{c}	2.33^{cd}	1.67^{ab}
T+RS+P	2.60^{c}	4.40^{c}	3.87^{b}	5.07^{bc}	10.43^{a}	3.67^{ab}
T+S	1.97^{c}	1.33^{d}	1.60^{cd}	2.90^{c}	4.40^{bcd}	3.70^{ab}
S+RS	4.73^{ab}	2.53^{cd}	1.60^{cd}	3.20^{c}	2.27^{d}	1.87^{ab}
T+P+RS+S	1.30^{c}	2.33^{cd}	3.07^{bc}	4.30^{bc}	6.60^{b}	4.67^{a}
			2010			
RS	0.70^{a}	0.75^{bc}	1.05^{cd}	2.10^{cd}	3.65^{de}	4.95^{f}
T+P	0.95^{a}	3.95^{a}	4.90^{a}	6.30^{a}	9.10^{a}	12.3^{a}
T	0.75^{a}	2.05^{b}	3.10^{b}	6.25^{a}	8.90^{a}	12.30^{ab}
RS+P	0.00^{a}	1.95^{bc}	0.55^{d}	6.15^{a}	7.50^{ab}	9.60^{cd}
S	0.00^{a}	0.00^{c}	2.45^{bc}	2.45^{bc}	2.45^{bc}	2.45^{bc}
T+RS+P	1.05^{a}	1.23^{bc}	2.45^{bc}	4.80^{ab}	6.90^{bc}	8.65^{d}
T+S	0.00^{a}	0.00^{c}	2.80^{b}	4.05^{b}	6.85^{bc}	10.45^{bc}
S+RS	0.00^{a}	0.00^{c}	0.00^{b}	1.40^{d}	5.25^{bc}	3.35^{g}
T+P+RS+S	0.00^{a}	0.00^{c}	2.40^{bc}	3.40^{bc}	2.50^{e}	7.00^{c}

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

RS = River sand, T+P = Topsoil + Poultry manure (4:1), T = Topsoil, RS+P = River sand + Poultry manure (3:1), S = Sawdust, T+RS+P = Topsoil + River sand + Poultry manure, (2:1:1), T+S = Topsoil + Sawdust (4:1), S+RS = Sawdust + River sand (3:1), T+P+RS+S = Topsoil +

At second planting, begonia planted in T+P (4:1) (12.30) (Table 4) was profuse in its flower production and maintained the highest number of flowers per plant throughout the course of the experiment as was the case at the first planting of this experiment. Plants grown in the media, T alone, were similar in flower production to those in T+P (4:1) such that by the 12th week, there was no significant difference in their flower production. Flower production in T+S (4:1), was relatively stable from the 9th to the 12th week (10.45). S+RS (3:1) was late in blooming and had the least (3.35) flower production even at the 12th week.

Discussion

It was observed that at first year planting, branches grew out earlier with more length compared to their performance during the second planting. The performance of the medium T+P (4:1) significantly increased the production of branches in beefsteak begonia, in the two planting years suggest the positive influence of poultry manure as a complementary source of nutrients. This most likely encouraged the growth and development of the branches. It is of note that T +RS +P (2:1:1) medium, though next in performance in support of branch production in beefsteak begonia supported the longest branch lengths suggesting that T+P (4:1) could be used with or without RS when planting with focus on branch production.

Leaves production is essential, as much as flowers production in any flower-producing ornamental plant. However, just as in branches growth and development, T+P (4:1) could be used with or without river sand to encourage and support a vibrant foliage growth. For the flowers, T+P (4:1) positively supported profuse flower production from the seventh (7th) week of the experiment till the termination of the study in the two years of planting. Nitrogen strongly influenced the development of foliage, flowers (ratings at 8 weeks after potting) and tuber production in container-grown tuberous begonias (Skalska, 1964; Gabriel and Onsem, 1972; Thomas and Ngu, 1991). Therefore, the poultry manure being a source of nitrogen had positively influenced the growth and development of these plant characters. It was observed in this study that plants grown in a combination of top soil and poultry manure, specifically T+P (4:1) produced larger canopies and exhibited less nutrient deficiency symptoms at the end of the study. This may have been due to the fact that organic nutrient sources in the growing medium remained present for a longer period and supplied substantial amounts of nutrients to the plants (Dede *et al.*, 2006). Considering a fertilizer feed program requirement of 200 ppm N, once a week for Dragonwing begonia, and the fact that severe fertility and/or water stress delay flowering 1 to 2 weeks, feeding regularly with an all-purpose fertilizer is needed (Pan American Seed, 2006). Usage of an alternative slow release nutrient source will be of great benefit to the plant and other members of the *Begoniaceae* family.

The slow growth and development of the studied plant characters, and late blooming and an low flower production in the media T+S (4:1) and S+RS (3:1), could be as a result of inadequate nutrients available in the media to the plants. This suggests the inability of sawdust containing medium to sustain beefsteak begonia production as it is of high cellulose and lignin content along with insufficient nitrogen supplies which create depletion problems and severely restrict plant growth (Ekpo and Sita, 2010). According to Olosunde and Fawusi (2003) reduced drainage and aeration in river sand as well as high carbon-nitrogen ratio, with improper decomposition and presence of growth inhibitors in the sawdust components could lead to poor plant growth. This suggests that beefsteak *begonia* does not require much carbon-containing medium (*i.e.* sawdust) for its growth and development. In view of the results obtained in this study, T+P (4:1), with or without river sand is suggested to be the suitable growth medium that will significantly enhance early rooting, establishment, growth and development of beefsteak begonia and sustain flower production for a good length of time.

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