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Philodendron domesticum **G. S. BUNTING PLANT RESPONSES TO POTTING MEDIA**

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ABSTRACT:

A pot experiment was conducted during the winter growing season of 2019/2020 under Glasshouse conditions, Faculty of Technology and Development, Zagazig University, Egypt to study effect of seven potting media on propagation and the subsequent growth and chemical composition of Philodendron domesticum G. S. Bunting plant. The tested potting media were peat moss, sand, cocopeat, peat moss+ sand (1:1, v/v), peat moss+ sand (2:1, v/v), cocopeat+ sand (1:1, v/v) and cocopeat+ sand (2:1, v/v). Planting cuttings in potting mixtures containing peat moss+ sand (1:1 v/v) or cocopeat+ sand (2:1 v/v) significantly accelerated cutting sprouting (determined 30 days after cutting plantation). While, peat moss and peat moss+ sand at 2:1 (v/v) media delayed cutting sprouting comparing to the other tested media. At the end experimental period, grow plants in peat moss + sand at 2:1 (v/v) medium produced more roots number per plant, the longest roots and the heaviest fresh and dry weights roots per plant comparing to plants grow in the other tested media.

Comparing plants grew in different tested media exhibited that plants grew in peat moss+ sand 2:1 (v/v) had the tallest plants, while the shortest plants were found in plants grow in sand medium. Also, plants that grew in medium mixture of peat moss+ sand (2:1, v/v) produced significant increases in leaf area per plant and attained the highest leaf area/ plant at the experimental end. Sand and cocopeat mixed with sand at 1:1 or 2:1 (v/v) resulted in the least leaf area per plant comparing to plants grew in the other tested media. In addition, peat moss+ sand (2:1, v/v) medium significantly increased number of produced leaves per plant and resulted in the highest stem thickness and the heaviest fresh and dry shoots/ plant, but plants grew in sand or in cocopeat mixed with sand either at 1:1 or 2:1 (v/v) recorded the least values in this regard.

Potting media effect was extended to the chemical composition of plant leaves. Peat moss+ sand (2:1, v/v) medium significantly increased chlorophyll a, total chlorophyll (a+ b) and carotenoids contents (mg/g FW) as well as total carbohydrates % in leaf tissues comparing to the other tested media.

Conclusively*, it could be recommended to use potting medium comprise by mixing peat moss and sand at 2: 1, respectively (v/v) as a rooting medium for propagation and growing Philodendron domesticum G. S. Bunting plant by sub-terminal stem cuttings*

Key words: Potting media, potting medium, *Philodendron domesticum* G. S. Bunting, peat moss, cocopeat & sand.

INTRODUCTION:

The use of foliage plants for interior decoration is an essential part of modern architecture and plays an important role in our lives (Manaker, 1997). Foliage plants production is a major agriculture field. Tropical foliage plants are commonly used in homes, hotels, offices, airports, and other public buildings (Dole and Wilkins, 2005). Foliage plants are in high demand for both export and domestic markets (Swetha *et al*, 2014).

Philodendron species are usually grown as evergreen herbaceous plants with attractive foliage that tolerate low light. This genus' species use their aerial roots for climb (Goncalves and Mayo 2000). *Philodendron domesticum* plant is one of the most essential and economical decorative tropical foliage plants (Chen *et al.*, 2002). It is usually grown as hanging baskets or as potted plants with vines supported by totem poles (Chen *et al*, 2005).

The potting medium has a major impact on the efficient growth of foliage plants (Swetha *et al.,* 2014). The potting medium supports the plant sufficiently, acts as a source for nutrients and water, and allows oxygen diffusion to the roots and gaseous exchange between the atmosphere and the roots (Abad *et al*., 2002).

Most commercially prepared potting mixes are containing no soil. Peat moss, sand, perlite, and vermiculite are the most common plant propagation materials. For rooting cuttings, clean sand may be mixed with peat moss or other organic materials. Peat moss represented the basic ingredient of such potting mixes. It has good physical and chemical properties that make it suitable as growing medium for propagation and growth of many ornamental plants. Increasing demand and rising costs of peat moss as a growing substrate have led to the search for low cost and high-quality substrates as an alternative (Moral *et al*., 2009).

Coconut or coir is a waste product of the coconut industry and has been proposed as a possible alternative to peat moss in growth media mixtures (Savithri and Hameed, 1994). Cocopeat has been considered as a substitute for the use of peat moss in horticulture practices. Cocopeat has good physical and chemical properties. It has many pores space, low shrinkage, high water content, low bulk density and slow biodegradation. Cocopeat is generally used for rooting cuttings and other vegetative propagation methods, hydroponic systems, cultivation of houseplants, soil conditioning, *etc.* (Basirat 2011).

There is an interest to increase sand ratio in the existing media in order to minimize the expense of imported costly organic products (Abo-Rezq *et al.,* 2009). According to Conover *et al*. (1991), various characteristics of the potting medium affect the rate at which nutrients are made available to foliage landscape plants. Potting media containing large amounts of sand may require slightly higher fertilizer levels because of decreases nutrient retention ability, especially where frequent or heavy leaching occurs.

However, the objective of the present study was to evaluate effect of some potting media comprised by mixing peat moss or cocopeat with sand at different proportions on propagation of *philodendron domesticum* G. S. Bunting plant by sub-terminal stem cuttings during winter season (September 20th until March 20th**).**

Therefore, the aim was extended to evaluate effect of the tested media mixtures on the subsequent plant growth and its chemical composition under glasshouse conditions.

MATERIALS AND METHODS

This study was carried out during the winter growing season of 2019/2020 under Glasshouse conditions, Faculty of Technology and Development, Zagazig University, Egypt to study the effect of potting media on propagation and subsequent growth and chemical composition of *Philodendron domesticum* G. S. Bunting plant.

Uniform *Philodendron domesticum* G. S. Bunting mother plants, Family *Araceae,* grown under the same conditions were donated on 20th September, from the privet orchard of Prof. Dr. Mahmood Khalil. Such plants were used for preparing sub-terminal cuttings.

The experimental treatments:

The experimental potting media treatments were included seven substrate mixtures as follows:

1. Peat moss
2. Sand

3. Cocopeat
4. Peat moss + Sand (1:1, v/v)
5. Peat moss + Sand (2:1, v/v)
6. Cocopeat + Sand (1:1, v/v)
7. Cocopeat + Sand (2:1, v/v).

The chemical properties of the experimented potting mixtures are presented in Table 1.

The experimental design was factorial experiment between the above-mentioned seven potting media and three sub-terminal cutting types in completely randomized block design with three replicates, each replicate contained 10 pots. This research was concerned with the main effect of the potting media.

The Procedures:

The three sub-terminal cutting types (single node, double node un-leafy and double node leafy cuttings) and the above-mentioned seven potting mixtures were prepared on 20th September. All the used cuttings were prepared with the same thickness of 0.85 cm. Length of the single node cutting was 3.0 cm, while the double node cuttings with or without leaf were 12.5 cm length. Plastic pots with 10 cm diameter and 10 cm depth were filled with the prepared potting media and the cuttings were planted immediately after their preparing. Single node cuttings were planted at a rate of four cuts per pot. While, double node with or without leaf cuttings were planted vertically in pots with coverage the base node. Two cuts were planed per pot for un-leafy cuttings, while leafy cuttings were planted at rate of one cut/ pot. After planting, all pots were irrigated and were left under glasshouse conditions without any artificial climate control. Average maximum and minimum (day/night) temperature (Cº) and relative humidity (%) within the glasshouse were recorded during the experimental period (from September until March), these data are shown in Table 2.Throughout the experimental period, all pots were overhead irrigated whenever needed (each 10 days in cool months and each 4-7 days in warm months). The pH and EC of irrigation water were 6.55 and 642 µs/cm, respectively. In warm months, a sunshade of 30 percent was used for protecting plants from sunburn. Also, beginning one month after planting of cuttings until the end of experiment, all treatments were biweekly foliar sprayed with aqua solution contained 1 g/ liter Delta Spray fertilizer which contained 19% N: 16% P_2O_5: 20% K_2O: 4% Mg+ trace elements; viz., B 0.25%, Mo 0.0005%, and Cu 0.01%.

Table 1: Chemical and physical analysis of the used potting media

Media	Physical analysis %					Salinity (ppm)	pH	Percentage %		
	Coarse sand	Fine sand	Silt	Clay	Organic matter			N	P	K
Peat moss	-	-	-	-	98.0	147.9	4.70	0.784	0.019	0.163
Sand	71.5	11.7	12.1	2.7	1.80	92.13	8.45	0.056	0.005	0.034
Cocopeat	-	-	-	-	98.0	192.0	7.12	0.433	0.018	0.783
Peat moss+Sand (1:1, V/V)	36.2	6.1	7.0	1.6	49.1	125.4	6.32	0.120	0.006	0.020
Peat moss+Sand (2:1, V/V)	21.6	5.8	8.0	1.4	60.2	196.7	4.79	0.083	0.006	0.053
Cocopeat+Sand (1:1, V/V)	33.5	7.0	6.6	1.8	43.1	138.3	8.17	0.041	0.005	0.092
Cocopeat+ Sand (2:1, V/V)	24.2	8.2	6.4	1.7	56.4	132.7	8.35	0.071	0.006	0.087

Table 2: Some recorded meteorological data within the experimental glasshouse of Faculty of Tec. & Dev., Zagazig Univ., Egypt during the experimental period of 2019/2020

Month	Temperature (ºC)		Relative humidity (%)	
	Maximum	Minimum	Maximum	Minimum
October 2019	26.5	19.5	87.5	72.5
November 2019	25.2	18.4	94.0	71.0
December 2019	27.4	20.2	98.6	76.4
January 2020	26.6	18.7	99.0	81.4
February 2020	28.9	17.3	99.0	71.7
March 2020	33.8	17.6	99.0	57.3

***Data Recorded**:*

Sprouting percentage after 30 days from cuttings planting:

It was calculated as an indicator to assess effect of treatments on propagation velocity according to the following equation:

$$\text{Sprouting \%} = \frac{\text{Number of sprouted cuttings after 30 days from planting}}{\text{Total number of planted cuttings}} \text{ X } 100$$

Survival percentage:

It was calculated on March 20th at the end of the experimental period according to the following equation:

$$\text{Survival \%} = \frac{\text{Number of survived plants at the experimental end}}{\text{Total number of planted cuttings}} \text{ X } 100$$

***Root growth parameters*:**

They were determined at the end of the experimental period including root length (cm), roots number / plant and roots fresh and dry weights/ plant (g).

***Vegetative growth parameters*:**

They were included plant height (cm), leaf area/ plant (cm^2), leaves number/ plant, stem thickness (mm) and shoot fresh and dry weights/ plant (g). Leaf area/ plant was calculated mathematically by determining the relationship between fresh weight of known leaf area (5 leaf disks) and leaf fresh weight/ plant. Plant height and leaves traits were recorded at three plant growth stages*; i.e.,* after 30 and 60 days from cuttings planting and at the end of experimental period of 180 days, while stem thickness and shoot fresh and dry weights were recorded only at the experimental end (180 days).

Chemical determinations:

Chemical determinations were performed at the end of the experiential period. Random leaf samples were taken and were dried at 70°C for 72 hours, finely ground and wet digested. Then, percentages of total nitrogen according to A.O.A.C (1980), total phosphorus according to Hucker and Catroux (1980), potassium according to Brown and Lilleland (1946) and total carbohydrate according to Dubois *et al.* (1956) were determined. In addition, chlorophylls a, b and a+ b were determined in fresh leaves according to the method descried by Robinson and. Britz (2000).

Statistical Analysis:

The collected data were statistically analyzed according to Steel and Torrie (1980). Mean separation was done using Duncan's multiple range test at 5 % level (Duncan, 1955). All achieved data were analyzed using IBM SPSS Software (SPSS, 2020).

RESULTS AND DISCUSSION

Sprouting, rooting and root growth:

It is clear that planting cuttings in potting mixtures containing peat moss + sand (1:1 v/v) or cocopeat + sand (2:1 v/v) significantly accelerated cutting sprouting (30 days after cutting plantation) comparing to the other examined media, without significant differences between the two treatments. Peat moss alone or mixed with sand at 2 peat:1 sand (v/v) and cocopeat + sand (1:1 v/v) showed low effect in enhancing cutting sprouting as compare to the other tested media (Table 3). Hassanein (2013) tested effect of sand, peat moss, perlite and mixture of sand + peat moss + perlite at 1:1:1 (v/v) media on cutting rooting of *Ficus hawaii* and *Chrysanthemum morifolium*, found that peat moss and sand media significantly increased rooting percentage of *Ficus hawaii* compared to perlite and the mixture of the three media. While, sand+ peat moss+ perlite at 1:1:1 (v/v) and perlite media gave the maximum rooting percentage for chrysanthemum cuttings. Hussain *et al*. (2017) explained the caused enhancing of *Caladium* tubers sprouting in combinations of organic (coconut compost and leaf manure) and inorganic (perlite) components as due to different media components were rich in different nutrients and the multi-nutrient substrates improved soil chemical and physical as well as biological properties.

As for number of produced roots per plant, data of the same Table 3 pointed that growing plants in peat moss or in peat moss + sand at 1:1 or 2:1 (v/v) media significantly encouraged roots production comparing to plants that grow in the other tested media. Such results show that there is no confirmed relationship between velocity of cutting sprouting and the end total produced number of roots on plant under the effect of different potting mixtures. On pothos plant, Garcia *et al.* (2001) concluded that plant growth of pothos might improve by inclusion of an organic component such as coconut coir dust or peat moss in the potting medium. Beattie and White (1992) stated that the development of root system demands well aerated growing medium with good water holding capacity, good drainage and good physical structure.

The highest roots spread was found in plants grow in cocopeat or peat moss + sand, 2:1 (v/v). Since, plants grow in these media had the longest roots comparing to roots of plants that grow in the other assessed media. In addition, growing plants in sand medium significantly suppressed roots spreading comparing to the other media (Table 3).

Also, results of Table 3 show that growing plants in peat moss + sand, 2:1 (v/v) medium resulted in significant increases in roots fresh and dry weights per plant (g) comparing to all the other tested media. The least roots fresh weight/ plant was found in plants grow in sand; while the least root dry weight/ plant was in plants grow in peat moss. However, decreasing roots fresh weight in plants grow in sand may expected as due to the inability of sand to hold water. Previous results of Yau and Murphy (2000) found that tomato plants grew on composted cocopeat medium produced higher root dry weight per plant.

In general, the results suggested that although plantation philodendron cuttings in medium mixture containing peat moss + sand at 2:1 (v/v) delayed cutting sprouting, grow the resulted plants in such medium produced more roots number per plant, longest roots and heaviest fresh and dry weights roots per plant comparing to plants grow in most of the other tested media. According to Riaz *et al.* (2014), plant roots are in direct contact with potting medium and any changes in their surrounding environment can have an effect on their growth. Therefore, the media formulation should provide an adequate balance between solid particles and pore spaces for good root growth.

Singh *et al*. (2010) studied effect of soil, sand, FYM, leaf mold, vermicompost and poultry growth media on *Dieffenbachia* root growth. They found that number of roots/ plants, root length and roots fresh and dry weights/ plant were significantly increased in plants grew in medium mixture containing sand + FYM (1:1, v/v).

On *Gardenia jasminoides* plants, Badran *et al.* (2017) tested the influence of three cultural media of peat moss, peat moss + sand (1:1, v/v) and peat moss + sand +clay (1:1:1, v/v/v) on root growth. They found that plants grew in peat

Table 3. Potting media effects on cutting sprouting and some root growth characteristic© of *Philodendron domesticum* G. S. Bunting during winter season of 2019/2020 under glasshouse conditions

Media	Percentage of sprouted cuttings (Sprouting velocity)	Root traits			
		No./ cutting	Length (cm)	Weight/ plant (g)	
				Fresh	Dry
Peat moss	26.9f	9.14a	21.0bc	2.93bc	0.447c
Sand	31.4bc	6.26bc	7.63e	1.51c	0.877bc
Cocopeat	30.1cd	6.90b	24.9a	3.56b	0.849bc
Peat+ Sand (1:1, v/v)	33.3ab	8.81a	16.5d	2.23bc	1.40b
Peat+ Sand (2:1, v/v)	27.3f	7.74ab	23.7ab	5.14a	2.60a
Coco+ Sand (1:1, v/v)	28.7ef	6.46bc	19.8c	2.17bc	1.18b
Coco+ Sand (2:1, v/v)	34.7a	4.69c	15.1d	1.73c	0.879bc

© Cutting sprouting was recorded after 30 days from planting while, the other root growth traits were recorded after 180 days from planting (at the experimental end on March 20th)

Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5% level.

moss medium alone resulted in significant increases in their roots dry weight per plant followed by plants in peat moss+sand mixture (1:1, v/v).

On *Aspidistra elatior* plant, Safaa Mohamed *et al.* (2020) tested the effect of different five potting media viz, Sand, Clay, Sand+ peat moss (1:1, v/v), Sand+ compost (1:1, v/v) and Sand+ peat moss+ compost (1:1:1, v/v/v). They showed that Sand+ peat moss+ compost (1:1:1, v/v/v) mixture gave maximum roots number/ plant and root length as well as fresh and dry weights of roots/ plant compared with the other cultural media.

On *Dracaena marginate* plant, Ashour *et al.* (2020) tested plant growth in two various cultural media. They used peat moss and peat moss + sand (1:1, v/v) media. They observed that maximum roots length and roots fresh and dry weights were in the plants grown in peat moss medium than those planted in peat moss + sand (1:1, v/v) mixture.

On *Spathiphyllum* plant, Fazeli Kakhki *et al.* (2020) evaluated effect of three potting media; *i.e.,* leaf mold, vermicompost, and (peat moss 20% + cocopeat 50% + perlite 30%). They found that maximum root fresh and dry weights were in plants grown in (peat moss 20% + cocopeat 50% + perlite 30%) mixture compared with leaf mold and vermicompost media.

On tomato plant, Alam *et al.* (2020) evaluated the influence of cultural media on growth of stem cuttings. They used four potting media viz., garden soil + FYM + silt (1:1:1, v/v/v), spent mushroom compost + silt (1:1, v/v), peat moss compost + silt (1:1, v/v) and pure peat moss. They found that the maximum root length, number of roots per plant, root fresh weight and root dry weight were recorded in pure peat moss media compared with garden soil + FYM + silt (1:1:1, v/v/v), spent mushroom compost + silt (1:1, v/v) or moss compost + silt (1:1, v/v) growth media.

Vegetative growth

Plant height of growing *Philodendron domesticum* G. S. Bunting was significantly affected with growing media during the experimental periods (Table 4). Generally, grow plants in cocopeat or in peat moss + sand 2:1 (v/v) recorded the tallest plants at 30, 90 and 180 days after cuttings planting, while the shortest plants at all growth periods were found in plants grow in sand medium. However, similar results were previously reported by Zaghloul (2001). He found that all mixtures media of peat + sand + loam, (1:1:1 v/v), sewage sludge + farm waste + cement dust (2:2:1 v/v), sewage sludge + farm waste + cement dust (5:4:1 v/v) and sewage sludge + farm waste (5:4 v/v) increased *Philodendron domesticum* plant height. The sewage sludge + farm waste + cement dust (2:2:1 v/v) mixture medium had the superior effects in this regard. Additionally, Mousa *et al.* (2004) found that pothos grew plants in peat moss alone or in mixture contained peat + sand (1:1, v/v) increased plant height comparing to plants grew in clay, peat + clay (1:1 v/v), peat + foam (3:1, v/v) and clay + foam (3:1, v/v) media. When Khayyat *et al.* (2007) planted *Epipremnum aureum* in mixtures of peat moss, cocopeat, sand and/ or leaf mold at several proportions, found that shoot length was significantly increased in plants grew in medium containing only cocopeat. While, sand medium resulted in less shoot length.

On *Dieffenbachia* plant, Singh *et al*. (2010) found that mixing sand with soil at 1:1, v/v significantly enhance plant height as compare to plants grew in soil or sand each alone.

Leaf area per plant (Table 4) follow similar trend as in plant height. Since, with little exceptions, the potting media that enhanced plant height at every plant growth period also increased leaf area/ plant. Conclusively, philodendron plants that grow in media mixture of peat moss+ sand (2:1, v/v) resulted in significant increases in leaf area per plant at the three tested growth

Table 4. Potting media effects on height and leaves area and number per *Philodendron domesticum* G. S. Bunting plant at different growth stages after propagation by sub-terminal stem cuttings during 2019/2020 winter season

Media	Plant height (cm)			Leaves per plant					
				Area (cm^2)			number		
	After[@] (days):			After (days):					
	30	90	180	30	90	180	30	90	180
Peat moss	4.24bc	12.0ab	25.2b	13.5b	25.1abc	377b	1.14a	2.11a	6.04ab
Sand	3.00c	8.00c	19.5d	10.6b	18.8c	186c	1.26a	2.02a	4.92d
Cocopeat	5.72ab	12.5ab	30.8a	19.0a	28.5a	415b	1.16a	2.26a	6.13ab
Peat+ Sand (1:1, v/v)	5.04ab	11.4ab	25.3b	19.4a	26.9ab	368b	1.38a	2.19a	5.78bc
Peat+ Sand (2:1, v/v)	5.17ab	13.3a	30.2a	20.3a	30.6a	565a	1.34a	2.21a	6.70a
Coco+ Sand (1:1, v/v)	6.50a	12.8ab	23.8bc	19.1a	24.3abc	252c	1.20a	2.18a	5.19cd
Coco+ Sand (2:1, v/v)	5.61ab	10.8b	20.2cd	12.8b	20.0bc	197c	1.11a	1.69a	4.03e

[@] Days after cuttings planting on September 20th.
Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5% level.

periods and attained the highest leaf area/ plant at the end of experiment (180 days after planting) comparing to plants that grow in the all-other tested potting media. At the same time, sand or cocopeat mixed with sand at 1:1 or 2:1 (v/v) resulted in the least significant leaf area per plant comparing to the other tested media.

As for leaves number per plant (Table 4), the tested potting media did not exhibit significant effect on leaves production by plant during the 1st and 2nd plant growth periods (from planting date until 90 days after planting). While, during the period of 90-180 days after planting (3rd growth stage) media of peat moss, cocopeat and peat moss+ sand (2:1, v/v) significantly increased leaf production by plant comparing to the other tested media. These three potting media recorded the highest leaves numbers/ plant. While, sand and cocopeat+ sand at 1:1 or 2:1 (v/v) media recorded the least leaves numbers per plant.

On *Dieffenbachia* plant, Singh *et al*. (2010) found that the maximum number of leaves per plants was exhibited in plans grew in sand + soil (1:1, v/v) medium as compare to plants grew in sand or soil each alone. Recently, Swetha *et al.* 2014 stated that *Aglaonema* plants grew in medium containing cocopeat + sand+ vermicompost at 2:1:1 (v/v) followed by the medium of cocopeat + sand+ FYM+ vermicompost at 2:1:1:0.5 (v/v) increased, while soil+ sand+ FYM at 2:1:1 (v/v) medium decreased leaves number and leaf area/ plant. However, they referred the enhancing effects of the above-mentioned media as due to the physical and chemical properties of cocopeat and vermicompost, since cocopeat has high water-holding capacity and it allows air, nutrients and water to reach the root surface, which may be a reason for vigorous and rapid growth. Furthermore, they explained pushing plant growth as due to the high nutrient status provided by vermicompost, and good physical and chemical traits of cocopeat, which would have resulted in higher nutrient uptake.

The media mixtures which enhanced root growth traits (Table 3) and vegetative growth characters (Table 4) also, significantly increased stem thickness and shoot fresh and dry weights per plant comparing to the other tested growth media (Table 5). In general, peat moss+ sand (2:1, v/v) medium resulted in the highest stem thickness and shoots fresh and dry weights/ plant, but plants grew in sand or in cocopeat mixed with sand either at 1:1 or 2:1 (v/v) recorded the least values in this regard. Additionally, plants grew in peat moss or cocopeat media also resulted thick stems. However, such results might be expected as due to the absorbed nutrients as well as the photosynthetic products by the good developed roots and shoots of plants grew in these media.

Similar results were previously reported on pothos plant. Mousa *et al.* (2004) tested media of clay, peat moss, peat + clay (1:1 v/v), peat + sand (1:1, v/v), peat + foam (3:1, v/v) and clay + foam (3:1, v/v) on pothos growth. They found that peat moss alone increased stem diameter and fresh and dry weights of shoots per plant compared to plants grew in the other tested media mixtures. The mixtures of peat with sand also, improved growth characteristics. Helal (2005) found that growing pothos plants in peat moss + sand, (1:1 v/v) medium resulted in the highest fresh and dry weights of shoot/pot comparing to plants grew in sand, peat moss, vermiculite and vermiculite + sand (1:1 v/v) media. When Khayyat *et al.* (2007) grew Golden pothos plants in twenty two potting mixtures comprised by mixing peat moss, cocopeat, sand and/ or leaf mold at several proportions for each, they found that shoot fresh and dry weights per plant were significantly increased in plants grew in medium containing only cocopeat. Sand medium resulted in less values of shoot fresh weight per plant, shoot length and leaf area per plant.

Table 5. Potting media effects on stem thickness and shoot fresh and dry weights per *Philodendron domesticum* G.S.Bunting plant after 180 days from propagation[@] by sub-terminal stem cuttings during 2019/2020 winter season under glasshouse conditions

Media	Stem thickness (mm)	Shoot weights/ plant (g)	
		Fresh	Dry
Peat moss	6.65a	12.4bc	1.05cd
Sand	4.33b	6.78d	.652de
Cocopeat	6.27a	14.8b	1.37bc
Peat+ Sand (1:1, v/v)	4.95b	12.0bc	1.59b
Peat+ Sand (2:1, v/v)	6.26a	19.0a	2.17a
Coco+ Sand (1:1, v/v)	4.97b	9.09cd	.881de
Coco+ Sand (2:1, v/v)	4.64b	6.15d	0.548e

[@] Cutting's planting was don on 20th September.
Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5% level.

Chemical determinations:

Leaf pigments:

Peat moss+ sand (2:1, v/v) medium significantly increased chlorophyll a, (a+b) and carotenoids contents (mg/g FW) as well as total carbohydrates % in leaf tissues comparing to most of the other tested media (Table 6). This result might be due to the caused enhancing in roots and shoots growth of plants that grew in such medium (as mentioned above in this research) which in turn may reflected as more nutrient absorption by spread roots and photosynthetic activity by the expanded leaves. As for chlorophyll b content, plants grew in peat+ sand at 1:1 or 2:1, (v/v) media showed the least significant values in this regard comparing to the other tested media. However, Zaghloul (2001) grew *Philodendron domesticum* plant in different mixture media of peat moss+ sand+ loam, 1:1:1 (v/v), sewage sludge+ farm waste+ cement dust, 2:2:1 (v/v), sewage sludge+ farm waste+ cement dust 5:4:1 (v/v) and sewage sludge+ farm waste, 5:4 (v/v). He found that sewage sludge+ farm waste+ cement dust, 2:2:1 (v/v) mixture medium resulted in the highest contents of chlorophyll a and b as well as total carbohydrates in leaf tissues comparing to plants grew in the other tested media.

Bidarnamani and Zarei (2014) found that grew pothos plants in medium containing cocopeat+ perlite (1:1, v/v) significantly decreased chlorophyll contents in leaves as compare to plants grew in leaf compost, rice husk, spent

Table 6. Potting media effects on some pigments and total carbohydrate contents in leaf tissues of *Philodendron domesticum* G. S. Bunting plant

Media	Leaf pigments contents				Total carbohydrates (%)
	Chlorophyll (mg/ g fresh weight)			Carotenoids (mg/ g fresh weight)	
	A	B	(A+B)		
Peat moss	0.801c	0.325abc	1.13c	0.282b	17.3e
Sand	0.758c	0.339abc	1.10c	0.277b	18.6b
Cocopeat	0.864c	0.437a	1.30bc	0.337ab	17.2f
Peat+ Sand (1:1, v/v)	1.28b	0.258bc	1.54b	0.359a	17.5d
Peat+ Sand (2:1, v/v)	1.65a	0.219c	1.86a	0.330ab	19.1a
Coco+ Sand (1:1, v/v)	0.692c	0.384ab	1.08c	0.311ab	18.6b
Coco+ Sand (2:1, v/v)	0.585c	0.441a	1.03c	0.304ab	18.2c

Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5% level.

mushroom compost or bark compost of forest trees mixed with equal volume of perlite. They referred reduction of chlorophyll contents in plants grew in cocopeat+ perlite (1:1, v/v) medium as dew to the significant decreases in uptake of N, Mg and/ or Fe elements, due to insolubility or unavailability of these elements in this pot mixture.

On *Dracaena marginate* plant, Ashour *et al.* (2020) assessed plant growth the in two various cultural media. They used peat moss and peat moss + sand (1:1, v/v) media. They observed that total chlorophyll in the leaves and total carbohydrates in the leaves and stems were increased in the plants grown in peat moss+ sand medium than those grown in peat moss alone.

Leaf N, P and K percentages:

The highest significant N percentage was found in leaves of plants grew in cocopeat+ sand (1:1, v/v) or in sand media followed by plants grew in peat+ sand (2:1, v/v) or cocopeat+ sand (2:1, v/v). While, peat moss+ sand (1:1, v/v) and cocopeat recorded the least values of N % in leaves (Table 7).

For phosphorus percentage, cocopeat+ sand (2:1, v/v) medium significantly increased P% in leaves, also peat moss+ sand (1:1, v/v) and cocopeat media resulted plants with least P% in their leaves. Moderate P

Table 7. Potting media effects on nitrogen, phosphorus, potassium percentages in leaf tissues of *Philodendron domesticum G. S. Bunting* plant

Media	Minerals (%)		
	N	P	K
Peat moss	2.22d	0.148d	3.26e
Sand	2.79a	0.150d	3.51b
Cocopeat	2.29c	0.118f	3.68a
Peat+ Sand (1:1, v/v)	2.34c	0.140e	2.99f
Peat+ Sand (2:1, v/v)	2.65b	0.158b	3.40c
Coco+ Sand (1:1, v/v)	2.78a	0.168a	3.35d
Coco+ Sand (2:1, v/v)	2.60b	0.153c	3.02f

Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5% level.

percentage was found in plants grew in peat moss+ sand (2:1, v/v) medium (Table 7). Marconi and Nelson (1984) published that peat moss has poor P-retaining ability.

Comparing effects of the tested media on K percentage, Table 7 showed that the highest significant K % was recorded in plants grew in cocopeat medium, but plants grew in peat moss, peat moss+ sand (1:1, v/v) or cocopeat+ sand (2:1, v/v) exhibited the least significant values in this regard. Planted plants in peat moss+ sand (2:1, v/v) medium showed moderate K percentage. However, Treder and Nowak (2002) said that cocopeat has high initial potassium content, so the fertilization program should be carefully tailored to plant requirements.

According to Conover *et al*. (1991), various characteristics of the potting medium affect the rate at which nutrients are made available to foliage landscape plants. Potting media containing large amounts of sand may require slightly higher fertilizer levels because of decreases nutrient retention ability, especially where frequent or heavy leaching occurs.

Hussain *et al*. (2017) assessed effect of ten potting media formed by mixing equal volumes of coconut compost, leaf compost, farmyard manure, compost, peat moss and/ or perlite with silt on leaf chemical constituents of *Caladium* plants. Comparing to plants grew in silt medium only; they noticed that adding any of the abovementioned-tested substrates to silt was associated with increasing chlorophylls, N, P, K and proteins contents in plant leaf tissues. The highest values in leaves in this respect were found in plants grew in silt+ coco peat+ leaf compost (1:1:1 v/v) followed in silt+ perlite+ leaf compost (1:1:1 v/v). Also, planting *Caladium* tubers in medium containing silt+ peat moss+ compost (1:1:1) significantly enhanced plant growth and its chemical constituents comparing plants grow in silt only. The researchers said that the used different media components, organic (coconut compost and leaf manure) and inorganic (perlite) components, were rich in different nutrients and the multi-nutrient substrates were improved the soil chemical, physical and biological properties, consequently nutrients uptake and plant growth were enhanced.

On *Celosia argentea* plant, Abd El Gayed and Attia (2018) studied impact of potting media on plants growth. They used three mixture of peat moss + sand (1:1 v/v), peat moss + sand (2:1 v/v), peat moss + sand (1:2 v/v). They recorded that the plants grown in peat + sand (2:1) produced the highest values of total chlorophyll contents, carbohydrate, N, P, and K % in leaf tissues. On the other hand, the lowest values of leaf N, P and K % were recorded when using peat + sand (1:2) medium.

On *Aspidistra elatior* plant, Safaa Mohamed *et al.* (2020) tested the effect of different five potting media viz., sand, clay, sand+ peat moss (1:1, v/v), sand+ compost (1:1, v/v) and sand+ peat moss+ compost (1:1:1, v/v/v). They showed that using sand+ peat moss+ compost (1:1:1, v/v/v) media increased chlorophyll a and b, nitrogen, phosphorus and potassium contents in leaves.

Survival percentage:

Potting media significantly affected on percentage of survived plants at the end of experimental period (Table 8 and Fig. 1). Plants grew in cocopeat+ sand (1:1, v/v) or in peat moss media recorded significant increases in survival percentages (45.9 and 44.7%, respectively) comparing to plants grew in the other examined media. At the same time, plants grew in peat moss+ sand (2:1, v/v) medium recorded the lowest survival percentage (36.8%), although they had the highest roots and vegetative growth of most of the evaluated features (as mentioned above in this research, Tables 3 - 5).

There is no apparent explanation for this outcome, and elucidating the cause would need more studies that may involve other specialties. However, Hassanein (2013) tested effect of sand, peat moss, perlite and mixture of sand + peat moss + perlite at 1:1:1 (v/v) media on *Ficus hawaii* and *Chrysanthemum morifolium* propagation, he noticed for ficus that, peat moss and sand media significantly increased percentage of survived plants compared to perlite and the mixture of the three media. While, sand, peat moss+ perlite and perlite media gave the maximum survival percentage for chrysanthemum cuttings.

Table 8. Potting media effects on survival percentage of *Philodendron domesticum* G.S. Bunting propagated during winter season of 2019/20 under glasshouse conditions

Media	Survival %
Peat moss	44.7ab
Sand	38.7c
Cocopeat	43.2b
Peat+ Sand (1:1, v/v)	37.7cd
Peat+ Sand (2:1, v/v)	36.8d
Coco+ Sand (1:1, v/v)	45.9a
Coco+ Sand (2:1, v/v)	39.1c

Means having same alphabetical letter(s) within each column did not significantly differ according to Duncan's multiple range test at 5%.
Survival percentage was calculated at the end of experimental period (180 days after cutting plantation, on 20th March).

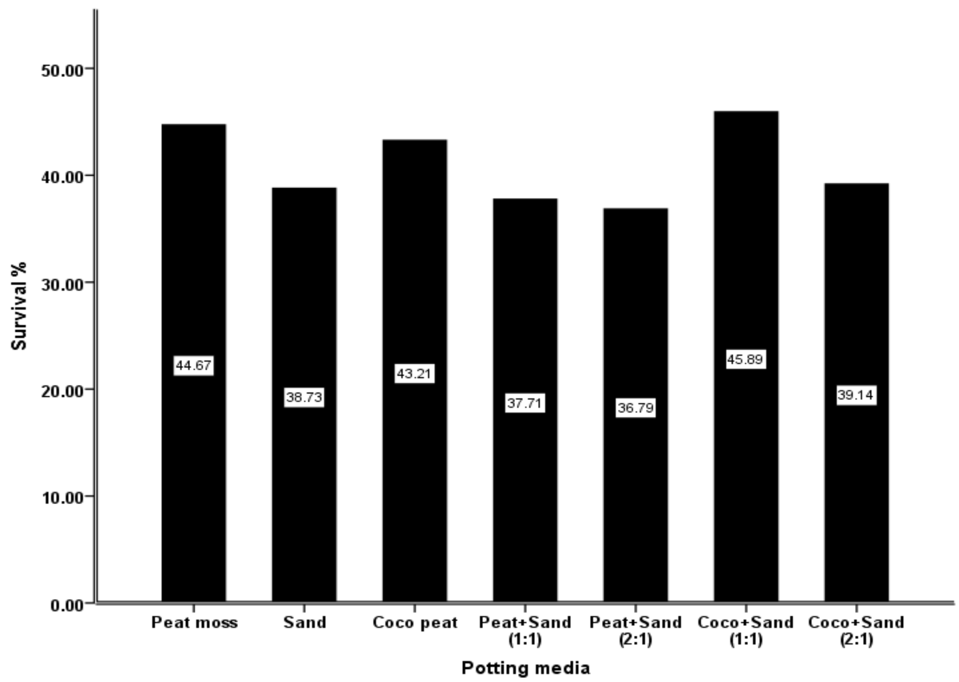

Fig. 1. Potting media effects on percentage of survived *Philodendron domesticum* G. S. Bunting plants at the experimental end on 20th

Conclusively, it could be recommended to use potting medium comprise by mixing peat moss and sand at 2: 1, respectively (v/v) as a rooting medium for propagation and growing Philodendron domesticum G. S. Bunting plant by sub-terminal stem cuttings

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استجابة نبات الفيلودندرون لبيئات الزراعة

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أُجريت تجربة فى اصص أثناء الموسم الشتوى 2020/2019 تحت ظروف الصوبة الزجاجية لكلية التكنولوجيا والتنمية ، جامعة الزقازيق ، مصر لدراسة أثر سبع بيئات نمو على الاكثار والنمو التالى والتركيب الكيمياوى لنبات الفيلودندرون "*Philodendron domesticum* G. S. Bunting" ، تضمنت بيئات النمو المختبرة كل من البيت موس ، الرمل ، بيت جوز الهند ، بيت موس+رمل (1:1 ججم/حجم) ، بيت موس+رمل (1:2 حجم/حجم) ، بيت جوز هند+رمل (1:1 حجم/حجم) ، بيت جوز هند+رمل (1:2 حجم/حجم).

أدى زراعة العقل فى خلائط محتوية على بيت موس+رمل (1:1 حجم/حجم) أو بيت جوز هند+رمل (1:2 حجم/حجم) إلى الاسراع فى تنبيت العقل (مقدراً عند 30 يوم بعد زراعة العقل) ، بينما أدت أوساط الزراعة المحتوية بيت موس أو بيت موس+رمل (1:2 حجم/حجم) إلى تأخير انبات العقل مقارنةً ببيئات النمو الاخرى المختبرة ، أنتجت النباتات النامية فى وسط بيت موس+رمل (1:2 حجم/حجم) عند نهاية التجربة عدد أكبر من الجذور بطول أطول ووزن غض وجاف لكل نبات أثقل مقارنة بالنباتات النامية فى بيئات النمو المختبرة الأُخرى.

أوضحت مقارنة النباتات النامية فى مختلف بيئات النمو المختبرة أن النباتات التى نُميت فى بيئة بيت موس+رمل (1:2 حجم/حجم) كانت أطول النباتات ، بينما كانت أقصر النباتات هى تلك التى نميت فى بيئة رمل ، أيضا انتجت النباتات التى نمت فى بيئة بيت موس+رمل (1:2 حجم/حجم) زيادات معنوية فى مساحة الاوراق للنبات وأحرزت أعلى زيادة فى المساحة الورقية للنبات عن نهاية التجربة ،

أنتجت بيئات الرمل ، وبيت جوز الهند المخلوط مع الرمل بنسبة 1:1 أو 1:2 (حجم/حجم) أقل مساحة ورقية للنبات مقارنة بالنباتات النامية فى بيئات النمو المختبرة الاخرى ، إضافة لذلك أنتجت بيئة الـ بيت موس+رمل (1:2 حجم/حجم) زيادة معنوية فى عدد الاوراق لكل نبات وانتجت أكبر سمك للساق وأثقل وزن غض وجاف للمجموع

الخضرى لكل نبات ، فى حين سجلت النباتات النامية فى بيئات الرمل ، وبيت جوز الهند المخلوط مع الرمل بنسبة 1:1 أو 1:2 (حجم/ حجم) أقل القيم بهذا الخصوص.

إمتد تأثير بيئات النمو إلى التركيب الكيميائى لأوراق النبات ، أدت بيئة الــ بيت موس+رمل (1:2 حجم/ حجم) إلى زيادات معنوية فى محتوى أنسجة الأوراق من كلوروفيل (أ) ، والكلوروفيل الكلى (أ+ب) والكاروتينا (مجم/ جم مادة غضة) وكذلك النسبة المئوية للكربوهيدرات الكلية مقارنةً ببيئات النمو المختبرة الأُخرى.

التوصية: ، يمكن التوصية باستخدام وسط زراعة مكون بخلط بيت موس ورمل بنسبة 1:2 على التوالى (حجماً) كوسط لإكثار نبات الفيلودندرون " *Philodendron domesticum* G. S. Bunting" بواسطة العقل الساقية الوسطية ولتنمية النباتات الناتجة للحصول على نباتات قوية جيدة النمو الخضرى والجذرى.