

Response of *Browallia speciosa* Hook. and *Thevetia peruviana* (Pers.) K. Schum. Plants to Some Growing Media and Fertilization Treatments

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ABSTRACT

In order to get the best landscape value of *Browallia speciosa* Hook. and *Thevetia peruviana* (Pers.) K. Schum. plants when used as pot plants the present study was conducted in a semi-shade place at the nursery of Orman Botanical Garden, Hort. Res. Inst., Giza, Egypt during 2016 and 2017 seasons, where one-year-old seedlings of the aforementioned two plant species were transplanted in 20-cm-diameter plastic pots filled with about 3.5 kg of one of the following media: pure sand (as control) or sand supplemented with 25 % (3:1, v/v) of either clay or farmyard manure (FYM). After 2 weeks from transplanting, the seedlings received 3 fertilization treatments as follows: ammonium sulphate $[(\text{NH}_4)_2\text{SO}_4, 20.5\% \text{ N}]$ at 2 g /plant, added monthly as soil drench for 5 times, and 2 forms of potassein [K-N (30 % $\text{K}_2\text{O} + 8\% \text{ N}$) and K-P (30 % $\text{K}_2\text{O} + 10\% \text{ P}_2\text{O}_5$)], added monthly for 5 times as foliar spray at 2 ml/l concentration for each. The effect of combined treatments between growing media and fertilization treatments was also studied.

The results of this study have shown that means of vegetative and root growth parameters (plant length, stem diameter, No. leaves/plant, root length and fresh and dry weights of leaves and roots) of the two studied plants were significantly increased in response to amending the sand with 25 % (3:1, v/v) of either clay or FYM, as well fertilizing with either form of potassein, with the superiority of both sand + 25 % (3:1, v/v) FYM growing media and K-N at 2 ml/l fertilization treatments, that gave the highest records in the two seasons. Thus, the best growth in both plants was attained by planting them in sand + 25 % (3:1, v/v) FYM mixture and spraying their foliage with 2 ml/l K-N aqueous solution. A similar trend was also obtained concerning the leaf content of chlorophyll a, b, carotenoids, N, P and K, with few exceptions.

So, it can be recommended to planting the one-year-old seedlings of both *Browallia speciosa* and *Thevetia peruviana* in a mixture composed of sand + 25 % (3:1, v/v) FYM and spraying their foliage with aqueous solution of potassein N at 2 ml/l concentration, 5 times with one month interval to get model pot plants of high quality.

Key words: *Browallia speciosa* and *Thevetia peruviana*, growing media, sand, clay, FYM, potassein forms, ammonium sulphate.

INTRODUCTION

Some ornamental plants can be use for many purposes, among them may be *Browallia* and *Thevetia*. The former (*Browallia speciosa* Hook, Fam. Solanaceae) is a Colombian tall annual, with abundant striated, dark purple flowers, all solitary, auxillary, peduncle shorter than the leaves. The leaves oblong ovate, petioled, sometimes opposite, sometimes alternate. It can be grown in poorer soil than most half-hardy annuals and make excellent bedding plants. They are also used for winter decoration proved placing them near the glass, and frequently stopped in order to produce compact plants. The small potted plants should be grown more commonly by florists for home decoration at Christmas. It is even possible to lift flowering plants from the open before the first frost of autumn and pot them for conservatory decoration. In pots under trees, *B. speciosa* makes excellent bedding plants. Propagation by seeds and cuttings, which may be sown in the open border, but for early bloom, it is better to start them indoors in early spring and transplant into the open by May 15th. The seeds being sown in midsummer, earlier or later according to the size of the specimens desired. Large

specimens are excellent for cutting (Bailey, 1976; Helmut, 1976).

The latter one is *Thevetia peruviana* (Pers.) K. Schum. (Fam. Apocynaceae). It is evergreen shrub, up to 9 m height; leaves nearly sessile, linear to linear-lanceolate, to 15 cm long and 6-6.5 mm wide, narrowly acuminate, dark green, glossy; flowers fragrant, yellow, to 5 cm across. Native to tropical America, propagated by cuttings and seeds. Thrives in rich sandy soil and will tolerate a few degrees of frost if banked with dry sand, used as solitary specimen and containerized small shrub (Bailey, 1976).

The good nutrition and using cheap organic alternative for high price peatmoss are considered one of the most important factors for producing containerized ornamental plants from commercial point of view. Moreover, peatmoss is jeopardized by its use as fuel or as growing medium (Nieto *et al.*, 2016). So, much research has been performed during the last years to find high quality and low cost substances from different organic wastes to avoid peat using. Among of these researches are those detected by Marfa *et al.*, (2002) who reported that cattle manure compost, forest waste compost, pine bark compost, Farm yard manure and raw coir

were the best peat-substitutes for the best growth of *Euonymus japonicus* plants. Likewise, Wazir *et al.*, (2004) found that amending the garden soil with leaf mould, FYM or greenfert composts recorded the maximum survival %, plant height, stem thickness, No. branches and leaves/plant, leaf area, No. roots, root length and thickness, root weight and crown thickness in *Schefflera actinophylla* plants. Similar observations were also revealed by Abdel-Fattah *et al.*, (2008) on *Brassia actinophylla*, El-Sayed *et al.*, (2013) on *Euonymus japonicus*, Nieto *et al.*, (2016) on *Lactuca sativa*, Burnett *et al.*, (2016) on *Poinsettia*, Niluni *et al.*, (2017) on *Plectranthus amboinicus* and *Plectranthus "Nicoletta"*, Sax and Scharenbroch (2017) on *Aronia melanocarpa* and *Acer saccharum* and Massa *et al.*, (2018) who noticed that the green compost derived from selected raw material was found to be a valuable growing medium for 30 and 50 % peat volume replacing in geranium (*Pelargonium zonale*) cultivation.

Fertilizing pot plants usually leads to considerable growth and development responses because their roots are restricted inside the pot. In this regard, Shahin *et al.*, (2007) elicited that spraying the foliage of *Hibiscus rosa-sinensis* transplants with K-N + K-P at 5 ml/l for each gave the tallest plants, the highest No. branches and leaves/plant, the largest leaf area, the heaviest fresh and dry weights of leaves, stem and roots, the widest flower diameter and the highest content of chlorophyll a, b, carotenoids, N, P and K compared to the untreated transplants. Similarly, El-Sayed *et al.*, (2008) observed that drenching *Ficus macrocarpa* var. Hawaii transplants grown in sand + loam + peatmoss (1:1:1, by volume) soil mixture with either NPK (1:1:1) compound fertilizer at 6 g/plant or spraying their foliage with K-N at 6 g/l greatly improved plant height, branch and leaf No./plant, root length, leaves, stem and roots fresh and dry weights, as well as pigments, total carbohydrates, N, P and K concentrations in the leaves, with the dominance of NPK treatment that recorded the utmost high means in most cases of both seasons. Analogous results were also explored by El-Sayed *et al.*, (2010) on *Vinca rosea* cv. Major, Shahin *et al.*, (2014) on *Merremia dissecta* and Alvarado Camarillo *et al.*, (2018) on *lisianthus*.

The effect of combining between growing media and fertilization on growth and chemical composition of ornamentals was also studied by Hammad *et al.*, (2005) whom revealed that connecting between planting carob (*Ceratonia siliqua*) seedlings in clay + compost mixture at a ratio of 1:2, v/v and fertilizing with ammonium nitrate (33.5 % N) at a rate of 6 g N/25-cm-diameter pot gave the highest values of plant height, stem diameter, No. leaves/plant, leaf area, fresh and dry weights of plant, as well as leaf content of total

carbohydrates, N, P and K. Further, El-Sayed *et al.*, (2009) affirmed that planting of *Nephrolepis exaltata* in peatmoss combining with 5 g/pot nitroben biofertilizer acquired the highest means of survival %, plant height, No. leaves/plant, root length and aerial parts and roots fresh and dry weights, while contents of pigments and total carbohydrates reached maximal values by planting in sand + clay + peatmoss mixture, alone or in combination with 5 g/pot nitroben, but for the percentages of N, P and K, this was attained by planting in sand + clay + spent mushroom compost mixture, solely or coupled with nitroben at 5 g/pot. These findings were supported by those discovered by El-Sayed and El-Shal (2008) on *Brassia actinophylla*, Shahin *et al.*, (2012) on *Brassia actinophylla* and *Euonymus japonicus* cv. Aureus, Sumathi *et al.*, (2017) on anthurium var. Tropical and Mohamed (2018) on Areca palm (*Dyopsis cabadae*).

However, the current work aims to find out the most proper growing medium and fertilization treatment for good performance of both *Browallia speciosa* and *Thevetia peruviana* plants when used as pot plants.

MATERIALS AND METHODS

Two independent pot experiments were undertaken in a semi-shade place at the nursery of Orman Botanical Garden, Hort. Res. Inst., Giza, Egypt through the two successive seasons of 2016 and 2017 in order to reveal the response of *Browallia* and *Thevetia* seedlings to some growing media, some fertilization treatments and their interactions when used as pot plants.

Thus, one-year-old seedlings of both *Browallia speciosa* Hook. at a length of 70-75 cm with 22-24 leaves and *Thevetia peruviana* (Pers.) K. Schum. at 22-25 cm length with 20-22 leaves were transplanted on first of April for every season in 20-cm-diameter plastic pots (one seedling / pot) filled with about 3.5 kg of one of the following media: sand without any amendments (as control), sand + 25 % clay (v/v) and Sand + 25 % (v/v) farmyard manure (FYM). The physical and chemical properties of the sand and clay used in the two seasons were determined and listed in Table (a), while those of FYM are shown in Table (b).

After two weeks from transplanting (on Mid of April), three fertilization treatments were applied as follows:

- 1- Chemical fertilization with ammonium sulphate $[(\text{NH}_4)_2\text{SO}_4, 20.5\% \text{ N}]$ at the rate of 2 g /plant, as a recommended dose for good growth, added monthly as soil drench for five times (Shahin *et al.*, 2012).

Table a: The physical and chemical properties of the sand and clay used in 2016 and 2017 seasons.

Soil type	Particle size distribution (%)				S.P.	E.C. (dS/m)	pH	Cations (meq/L)				Anions (Meq/L)		
	Coarse sand	Fine sand	Silt	Clay				Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻
Sand	85.03	6.05	1.40	7.52	22.67	3.31	7.83	7.50	1.63	33.60	0.50	3.20	22.00	18.03
Clay	7.46	16.75	33.53	41.89	41.68	2.19	7.96	16.93	9.33	20.44	0.37	3.82	1.50	41.75

Table b: The physical and chemical properties of farmyard manure (FYM) used in 2016 and 2017 seasons.

Macro elements (%)					Micro elements (ppm)				O.C. (%)	O.M. (%)	C/N ratio	pH	E.C. (dS/m)
N	P	K	Ca	Mg	Zn	Fe	Mn	Cu					
1.85	0.71	2.29	0.23	0.81	20.10	1620	330	54	23.28	25.80	12.58	7.81	3.50

2- Aqueous solutions of either potassein-N (a liquid fertilizer contains 30 % K₂O and 8 % N) or potassein-P (a liquid fertilizer contains 30 % K₂O and 10 % P₂O₅), both produced by Ministry of Agriculture, Egypt at 2 ml/l concentration for each, added as foliar spray till the solution was run-off, five times with one month interval.

3- Each fertilization treatment was combined with each one of growing medium to form 9 interaction treatments.

The layout of the two experiments in both seasons was a complete randomized design in factorial experimental type, replicated twice, as each replicate contained 5 plants (Mead *et al.*, 1993). The usual agricultural practices recommended for such plantation were achieved as grower did.

At the end of every season (on October, 15th), the following data were recorded for each plant: plant length (cm), stem diameter (cm), number of leaves/plant, root length (cm), as well as leaves and roots fresh and dry weights (g). In fresh leaf samples taken from the middle parts of both plants in the second season only, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) were measured using the quick method of Yadava (1986), while in dry samples, the percentages of nitrogen, phosphorus and potassium were assessed according to the methods described by Black (1956), Luatanab and Olsen (1965) and Page *et al.*, (1982), respectively.

Data were then tabulated and subjected to analysis of variance using program of SAS Institute (2009), which was followed by Duncan's New Multiple Range Test (Steel and Torrie, 1980) to compare significance among the means of various treatments.

RESULTS AND DISCUSSION

Effect of growing media, fertilization treatments and their interactions on:

1- Vegetative and root growth parameters of both plants:

According to data presented in Tables from (1) to (8), it is clear that means of all vegetative and root growth traits, expressed as: plant length (cm), stem diameter (cm), No. of leaves/plant, root length

(cm), as well as fresh and dry weights (g) of both leaves and roots in the two studied plants were markedly improved in response to amending the sand with either clay or FYM at the percent of 25 %, with the superiority of sand + 25 % FYM medium, which gave the highest means in all characters mentioned above over pure sand and sand + 25 % clay media, with significant differences in most cases of the two seasons. This may be attributed to the role of farmyard manure in improving fertility of the growing medium, as it has a high manurial value for plant growth (Nieto *et al.*, 2016). It may improve soil structure and texture, increase cation exchange capacity, improve water holding capacity and nutrient retention and create a suitable environment for root proliferation and biomass growth (Sax and Scharenbroch, 2017). In this regard, Burnett *et al.*, (2016) mentioned that growers who mix their growing substrates with organic compost that has high water holding and cation exchange capacity at percentages ranging from 20 to 50 % produced high quality container plants of *Begonia x semperflorens cultorum*, *Catharanthus roseus*, *Cyclamen persicum*, *Petunia x hybrida*, *Salvia farinacea* and *Poinsettia*.

Likewise, Niluni *et al.*, (2017) postulated that planting *Plectranthus amboinicus* and *Plectranthus "Nicoletta"* in Promix-BXTM growing medium amended with 20 % of vermicasts had significantly high fresh weight and leaf area index compared to plants grown in medium amended with 20 % of either K-humate or N₂₀P₂₀K₂₀. Mashinchian *et al.*, (2017) declared that growth of *Spathiphllum wallisii* is much better in media containing 40 % cocopeat and 60 % peatmoss, while Leca (expanded clay) and Styrofoam can be used at 25 % only because an excessive amount of them led to a change in the physical characteristics of the media and a drop in the growth rate of the plant. On *Pelargonium zonale*, Massa *et al.*, (2018) indicated that applying the green compost at 30 and 50 % as peat substitute was found to be a valuable in preparing growing medium used for improving growth and quality of such plant.

Similarly, the two forms of potassein (K-N and K-P) caused a clear improvement in all vegetative and root growth attributes stated before relative to

the recommended dose of $(\text{NH}_4)_2\text{SO}_4$ (2 g/plant) in both plant species with significant differences in most instances of the two seasons. However, the prevalence was for fertilizing with K-N at 2 ml/l, that recorded the utmost high values in both seasons. This may be ascribed to the function of potassium (K^+) on cell division and elongation, proteins and carbohydrates formation, activating translocation of sugars and starch from leaves to plant organs and its role as co-factor for about 60 enzymatic systems involved in plant growth (Cakmak, 2005). It is also involved in stomatal regulation of transpiration and photosynthesis, photophosphorylation, transportation of photoassimilates from source tissues to sink ones via the phloem, turgor maintenance and stress tolerance (Alvarado-Camarillo, 2018). Including potassein forms with either N or P increases their beneficial effects, as the former (N) is the main constituent of all proteins, nucleic acids and most structural and non-structural components of plant cells. The latter (P) is involving in energy transfer process and in building of phospholipids and nucleic acids (Handreck and Black, 2002; Broschat, 2006).

The role of fertilizers in enhancing growth and quality of ornamentals was previously documented by Shahin *et al.*, (2007) on *Hibiscus rosa-sinensis*, El-Sayed *et al.*, (2008) on *Ficus macrocarpa* var. Hawaii and Abou-Dahab *et al.*, (2008) who found that ammonium nitrate at the rate of 7 g/plant of *Moluccella laevis* scored the best values of plant length, No. branches/plant, stem diameter, No. leaves/plant, inflorescence stalk length and dry weight of plant, followed by the mixed fertilizer (Tamarind seed gum (12g) + ammonium nitrate (1.75 g)/plant and then organic manure at the rate of

24 g/plant. On *Merremia dissecta*, Shahin *et al.*, (2014) clarified that a combined treatment of 10 ml/l humic acid and 5 ml/l K-N resulted better growth than the recommended dose of NPK (2:1:1) at 2 g/plant and than applying each fertilizer alone. Recently, Alvarado-Camarillo *et al.*, (2018) observed that lisianthus plants grown in volcanic rock and fertigated with a N/K balance of 2.14 exhibited taller stem and heavier stem dry weight than those fertigated with a balance of 4.29, and higher flower buds count and total dry weight than those fertigated with a balance of 1.43 or 4.29. Furthermore, plants fertigated with a balance of 2.14 gave higher dry weight when N was reduced from 15 to 9 meq/l and K from 7 to 4.2 meq/l, suggesting that lisianthus does not require high levels of these nutrients.

Interaction treatments also exert a pronounced effect on vegetative and root growth of both browallia and thevetia plants, where the interacting between planting in sand + 25 % FYM growing mixture and fertilizing with either K-N or K-P at 2ml/l for each, recorded the utmost high values in most measured parameters of the two plant species over all other interactions, with non significant differences among themselves in both seasons. However, the mastership was for combining between planting in sand + 25 % FYM mixture and fertilizing with K-N at 2 ml/l that gave the highest means in most cases of the two seasons. This may be due to lump the benefits of both FYM as a fertile and enhancer amendment for chemical and physical properties of the growing mixture and K-N as a quick soluble fertilizer providing the plants with two main macro-elements (N and K) necessary for healthy growth.

Table 1: Effect of growing media, fertilization treatments and their interactions on plant length and stem diameter of *Browallia speciosa* Hook. plants during 2016 and 2017 seasons

Media	Fertilization treatments ($\text{NH}_4)_2\text{SO}_4$ (2g/plant)	Plant length (cm)			Stem diameter (cm)			
		K-N (2 ml/l)	K-P (2 ml/l)	Mean	($\text{NH}_4)_2\text{SO}_4$ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016								
Sand (S)	120.33g	129.13e	124.76f	124.74c	0.55c	0.64ab	0.60b	0.60b
S + 25 % clay	134.26d	143.50b	138.00c	138.59b	0.61b	0.70a	0.65ab	0.65a
S + 25 % FYM	143.48b	149.81a	146.93ab	146.74a	0.60b	0.70a	0.65ab	0.65a
Mean	132.69c	140.81a	136.56b		0.59b	0.68a	0.63b	
Second season: 2017								
Sand (S)	126.32g	135.50e	129.48f	130.43c	0.56c	0.67ab	0.62b	0.62b
S + 25 % clay	141.10d	148.76c	145.00cd	144.95b	0.58bc	0.75a	0.66ab	0.66ab
S + 25 % FYM	150.00b	156.93a	153.33ab	153.42a	0.63b	0.74a	0.69ab	0.69a
Mean	139.14c	147.06a	142.60b		0.59c	0.72a	0.66b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at $P = 5\%$.

Table 2: Effect of growing media, fertilization treatments and their interactions on plant length and stem diameter of *Thevetia peruviana* (Pers.) K. Schum. plants during 2016 and 2017 seasons

Media	Plant length (cm)				Stem diameter (cm)			
	Fertilization treatments (NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016								
Sand (S)	44.38d	51.31bc	46.50d	47.40c	0.41d	0.50c	0.50c	0.47c
S + 25 % clay	51.00c	56.55ab	52.53bc	53.36b	0.50c	0.63ab	0.58b	0.57b
S + 25 % FYM	55.10b	59.37a	57.48a	57.32a	0.60b	0.70a	0.65ab	0.65a
Mean	50.16b	55.74a	52.17ab		0.50b	0.61a	0.57ab	
Second season: 2017								
Sand (S)	45.50d	53.60c	48.83d	49.31c	0.42d	0.51c	0.53c	0.49c
S + 25 % clay	54.00c	58.33ab	54.26bc	55.53b	0.50c	0.65ab	0.61b	0.59b
S + 25 % FYM	58.10b	62.00a	58.92ab	59.67a	0.58b	0.73a	0.71a	0.67a
Mean	52.53b	57.98a	54.00ab		0.50b	0.63a	0.62a	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 3: Effect of growing media, fertilization treatments and their interactions on number of leaves and root length of *Browallia speciosa* Hook. plants during 2016 and 2017 seasons

Media	Number of leaves/plant				Root length (cm)			
	Fertilization treatments (NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016								
Sand (S)	25.76f	27.91f	26.33f	25.67c	23.71e	29.51cd	27.33d	26.85c
S + 25 % clay	35.41e	41.83d	39.68de	38.97b	32.10c	37.07b	34.78bc	34.65b
S + 25 % FYM	47.80c	67.50a	52.65b	55.98a	36.17b	43.92a	41.50a	40.53a
Mean	35.66c	45.75a	39.22b		30.66c	36.83a	34.54b	
Second season: 2017								
Sand (S)	24.90g	27.50f	26.56f	26.32c	23.78d	30.11c	25.50d	26.46c
S + 25 % clay	35.50e	43.10cd	41.70d	40.10b	33.62bc	36.54b	33.96bc	34.71b
S + 25 % FYM	46.00c	68.00a	54.61b	56.20a	35.79b	42.87a	41.33a	40.00a
Mean	35.47c	46.20a	40.96b		31.06c	36.51a	33.60b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 4: Effect of growing media, fertilization treatments and their interactions on number of leaves and root length of *Thevetia peruviana* (Pers.) K. Schum. plants during 2016 and 2017 seasons

Media	Number of leaves/plant				Root length (cm)			
	Fertilization treatments (NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016								
Sand (S)	39.00e	47.31d	45.00d	43.77c	19.50e	21.58d	20.00de	20.36b
S + 25 % clay	47.96d	63.15b	51.76cd	54.29b	23.49cd	27.35b	25.88bc	25.57ab
S + 25 % FYM	55.12c	81.53a	63.78b	66.81a	25.00c	30.46a	27.10b	27.52a
Mean	47.36c	64.00a	53.51b		22.66c	26.46a	24.33b	
Second season: 2017								
Sand (S)	40.91d	49.35d	44.50e	44.92c	21.45e	23.70d	21.00e	22.05c
S + 25 % clay	50.30d	65.10b	53.07cd	56.16b	25.00cd	28.81b	26.93c	26.91b
S + 25 % FYM	57.67c	80.73a	66.15b	68.18a	26.31c	32.17a	28.32b	28.93a
Mean	49.63d	65.06a	54.57b		24.26c	28.23a	25.42b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 5: Effect of growing media, fertilization treatments and their interactions on leaves and roots fresh weight of *Browallia speciosa* Hook. plants during 2016 and 2017 seasons.

Media	Fertilization treatments	Leaves fresh weight (g)				Roots fresh weight (g)			
		(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016									
Sand (S)		3.32e	4.33de	3.78e	3.81c	2.89d	3.43cd	3.21d	3.18b
S + 25 % clay		5.76d	6.63cd	6.10cd	6.16b	3.50cd	4.07c	3.92c	3.83b
S + 25 % FYM		7.49c	15.14a	9.15b	10.59a	5.33b	7.26a	5.27b	5.95a
Mean		5.52c	8.70a	6.34b		3.91b	4.92a	4.13ab	
Second season: 2017									
Sand (S)		3.50e	4.48e	4.00e	3.99c	3.00d	3.60cd	3.38d	3.33c
S + 25 % clay		6.06d	6.91cd	6.41cd	6.46b	3.68cd	4.31c	4.10c	4.03b
S + 25 % FYM		7.78c	13.50a	10.33b	10.54a	5.61b	7.67a	5.58b	6.29a
Mean		5.78c	8.30a	6.91b		4.10b	5.19a	4.35b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 6: Effect of growing media, fertilization treatments and their interactions on leaves and roots fresh weight of *Thevetia peruviana* (Pers.) K. Schum. plants during 2016 and 2017 seasons.

Media	Fertilization treatments	Leaves fresh weight (g)				Roots fresh weight (g)			
		(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016									
Sand (S)		7.90d	10.67c	8.98cd	9.18c	6.35c	6.78c	6.59c	6.57c
S + 25 % clay		10.78c	13.74b	11.16bc	11.89b	7.76bc	8.57b	8.14b	8.16b
S + 25 % FYM		12.38bc	17.73a	13.75b	14.62a	8.10b	9.65a	8.79ab	8.85a
Mean		10.35b	14.05a	11.30b		7.40b	8.34a	7.84ab	
Second season: 2017									
Sand (S)		7.79de	11.15c	9.51d	9.48c	5.97d	7.15c	6.95c	6.69c
S + 25 % clay		10.36c	14.39b	11.80bc	12.18b	7.83bc	9.10b	8.55b	8.49b
S + 25 % FYM		12.58bc	18.50a	14.47b	15.18a	8.51b	10.13a	9.30ab	9.31a
Mean		10.24c	14.68a	11.93b		7.44b	8.79a	8.27ab	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 7: Effect of growing media, fertilization treatments and their interactions on leaves N and roots dry weight of *Browallia speciosa* Hook. plants during 2016 and 2017 seasons.

Media	Fertilization treatments	Leaves dry weight (g)				Roots dry weight (g)			
		(H ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016									
Sand (S)		0.81c	1.07c	0.93c	0.94b	1.28c	1.55c	1.43c	1.42b
S + 25 % clay		1.43bc	1.68bc	1.50bc	1.54b	1.58bc	1.85bc	1.76bc	1.73b
S + 25 % FYM		1.87bc	3.79a	2.26b	2.64a	2.37b	3.27a	2.38b	2.67a
Mean		1.37b	2.18a	1.56b		1.74b	2.23a	1.86b	
Second season: 2017									
Sand (S)		0.86c	1.13c	0.98c	0.99b	1.35c	1.63c	1.51c	1.50b
S + 25 % clay		1.50bc	1.80bc	1.61bc	1.64b	1.70bc	1.96bc	1.85bc	1.84b
S + 25 % FYM		2.00b	4.00a	2.50b	2.83a	2.50b	3.47a	2.56b	2.84a
Mean		1.45b	2.31a	1.70b		1.85b	2.35a	1.97b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

Table 8: Effect of growing media, fertilization treatments and their interactions on leaves and roots dry weight of *Thevetia peruviana* (Pers.) K. Schum. plants during 2016 and 2017 seasons.

Media	Leaves dry weight (g)				Roots dry weight (g)			
	Fertilization treatments (NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
First season: 2016								
Sand (S)	2.31c	3.20bc	2.68c	2.73c	3.48c	3.73bc	3.61c	3.61b
S + 25 % clay	3.25bc	4.15b	3.35bc	3.58b	4.23b	4.73ab	4.46b	4.47ab
S + 25 % FYM	3.72bc	5.31a	4.10b	4.38a	4.41b	5.31a	4.73ab	4.82a
Mean	3.09b	4.22a	3.38b		4.04b	4.59a	4.27ab	
Second season: 2017								
Sand (S)	2.37c	3.36bc	2.59c	2.77c	3.50c	3.89bc	3.50c	3.63b
S + 25 % clay	3.41bc	4.37b	3.41bc	3.73b	4.45b	4.95ab	4.70b	4.70ab
S + 25 % FYM	3.90bc	5.50a	4.33b	4.58a	4.61b	5.60a	4.93ab	5.05a
Mean	3.23b	4.41a	3.44b		4.19b	4.81a	4.38b	

Means followed by the same letter in a column or row don't differ significantly according to Duncan's New Multiple Range Test at P = 5 %.

These gains are supported by the results of Shahin *et al.*, (2012) who revealed that planting *Brassia actinophylla* and *Euonymus japonicus* transplants in sand + 25 % FYM mixture and fertilizing them with Kristalon (2g/plant) + active dry yeast (5 g/l) acquired better vegetative and root growth accompanied with higher quality. On cut flowers of anthurium var. Tropical, Sumathi *et al.*, (2017) reported that flowers produced from plants cultivated in coconut husk + charcoal (3:1) as growing media along with foliar spray of NPK (12:61:40) at 2 % showed maximum water uptake, fresh weight retention and increased vase life compared to other combinations. In addition, Mohamed (2018) decided that growing *Dypsis cabadae* palm plants in a mixture of compost + peatmoss + perlite (1:1:1, by volume) supplemented with kristalon at 8 g/pot produced the tallest plant, the heaviest fresh and dry weights of leaves and stem/plant, the longest stem and root lengths and the heaviest roots fresh and dry weights. Besides, the highest No. leaves/plant, stem diameter, plant width and No. roots/plant. However, the greatest show value of such palm as pot plant was attained by using the mixture composed of clay + sand + compost + peatmoss + perlite + kristalon at 8 g/pot.

2- Chemical constituents contents in the leaves of both plants:

A similar trend to that of vegetative and root growth characters was also obtained regarding the effect of different treatments employed in this study on chemical composition of the leaves in the two tested plants, where fortifying the sand with 25 % of either clay or farmyard manure markedly improved concentrations of chlorophyll a, b and carotenoids (mg/g f.w.) and the percentages of N, P and K in the leaves of both plants (Tables, 9 and 10), and the upper hand was also for sand + 25 % FYM mixture which gave the highest records at all. These findings may indicate the role of FYM in improving fertility of the

growing mixture and supplying the plants slowly with more nutrients necessary for good growth. In this respect, Gonzalez and Cooperband (2003) pointed out that duck manure increased total soil content of C, N, P and Cu, as well as available P, S, Ca, Mg, K and Zn. On *Euonymus japonicus* cv. Aureus, El-Sayed *et al.*, (2013) revealed that amending the sand with olive meal compost, soybean meal compost and broad bean hulls compost at equal parts greatly increased chlorophyll a, b, carotenoids, total sugars, N, P and K in the leaves compared to plants grown in pure sand. Besides, Massa *et al.*, (2018) indicated that applying the green compost at 30 or 50 % to the growing medium of *Pelargonium zonale* raised N, P, K, Ca, Mg and Zn in the leaves compared with planting in peat only.

The two forms of potassein fertilizer are also increased content of the previous chemical components in the leaves of both plants except for carotenoids content which was declined as a result of dressing with such potassein forms relative to (NH₄)₂SO₄ treatment. In general, K-N achieved, to some extent better results than K-P, giving higher contents of aforementioned constituents, with the exception of P content, as K-P form resulted higher concentration of such element in the leaves of both plants. These results are in accordance with those pointed out by Shahin *et al.*, (2007) on *Hibiscus rosa-sinensis*, El-Sayed *et al.* (2010) on *Vinca rosea* cv. Major, Shahin *et al.*, (2014) on *Merremia dissecta* and Alvarado Camarillo *et al.*, (2018) whom suggested that N/K balance of 2.14 in substrate solution increased N concentration in the shoot of lisianthus plants, which was associated with higher P and Mg in the plant tissues. Shoot K concentration significantly increased when the N/K balance decreased due to the higher concentration of external K when the balance decreased.

The chemical composition of the studied plants leaves was markedly affected by the combined treatments, where interacting between planting in sand fortified with 25 % FYM and fertilizing with either form of potassein registered the higher content of various constituents measured in this study than the other interactions, with the dominance of S + 25 % FYM and 2 ml/l K-N combination that recorded the utmost high values of measured components, except for P values that reached maximum by planting in the same growing mixture and dressing with K-P at 2ml/l. These gains may be reasonable due to lumping the positive effects of FYM as a slow release organic source supplying the plants continuously with minerals and potassein forms that save N, P and K luxuriously for the plants. In this connection, Shahin *et al.*, (2012) declared that combining between kristalon (2g/plant) + active dry yeast (5 g/l) and planting in the sand strengthened with 25 % FYM elevated concentrations of chlorophyll a, b, carotenoids, N, P

and K in the leaves of both *Brassaia actinophylla* and *Euonymus japonicus* transplants to the maximal averages. Moreover, Sumathi *et al.*, (2017) found that flowers produced from anthurium var. Tropical plants cultivated in coconut husk + charcoal mixture and foliar sprayed with 12 N: 61 P: 40 K at 0.2 % contained the highest total soluble sugars in their leaves. Recently, Mohamed (2018) postulated that growing *Dypsis cabadae* palm plants in compost + peatmoss + prelite (1:1:1, v/v/v) mixture supplemented with 8g/pot kristalon produced the highest total chlorophylls, carbohydrates, N, P, K, auxin, gibberellins and cytokinins with the lowest leaf abscisic acid content.

From the aforementioned results, it is advised to growing one-year-old seedlings of either *Browallia speciosa* or *Thevetia peruviana* in a mixture of sand + 25 % FYM and spraying their foliage with potassein – N at 2 ml/l concentration to obtain picturesque and healthy specimens used as pot plants.

Table 9: Effect of growing media, fertilization treatments and their interactions on some chemical constituents contents in *Browallia speciosa* Hook. leaves during 2017 season.

Fertilization treatments	Chlorophyll a (mg/g f.w.)				Chlorophyll b (mg/g f.w.)				Carotenoids (mg/g f.w.)			
	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2ml/l)	K-P (2ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2ml/l)	Mean
Sand (S)	0.707	0.792	0.725	0.741	0.284	0.345	0.312	0.314	0.347	0.282	0.268	0.299
S + 25 % clay	0.935	1.014	0.964	0.971	0.365	0.405	0.399	0.390	0.387	0.392	0.388	0.389
S + 25 % FYM	1.036	1.403	1.028	1.156	0.431	0.533	0.432	0.465	0.524	0.461	0.455	0.480
Mean	0.893	1.070	0.906		0.360	0.428	0.381		0.419	0.378	0.370	
	N (%)				P (%)				K (%)			
Sand (S)	1.756	2.126	1.581	1.821	0.078	0.081	0.104	0.088	1.567	1.727	1.688	1.660
S + 25 % clay	1.897	2.101	1.703	1.900	0.085	0.097	0.117	0.100	1.763	1.907	1.896	1.855
S + 25 % FYM	2.312	2.396	2.076	2.261	0.107	0.099	0.133	0.113	2.031	2.233	2.118	2.127
Mean	1.988	2.208	1.787		0.090	0.092	0.118		1.787	1.955	1.901	

Table 10: Effect of growing media, fertilization treatments and their interactions on some chemical constituents contents in *Thevetia peruviana* (Pers.) K. Schum. leaves during 2017 season.

Fertilization treatments	Chlorophyll a (mg/g f.w.)				Chlorophyll b (mg/g f.w.)				Carotenoids (mg/g f.w.)			
	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean	(NH ₄) ₂ SO ₄ (2g/plant)	K-N (2 ml/l)	K-P (2 ml/l)	Mean
Sand (S)	0.523	0.921	0.753	0.732	0.158	0.201	0.173	0.177	0.533	0.495	0.419	0.482
S + 25 % clay	1.032	1.254	1.166	1.151	0.365	0.431	0.425	0.407	0.599	0.497	0.541	0.546
S + 25 % FYM	1.415	1.653	1.568	1.545	0.512	0.683	0.602	0.599	0.650	0.587	0.588	0.608
Mean	0.990	1.276	1.162		0.345	0.438	0.400		0.594	0.526	0.516	
	N (%)				P (%)				K (%)			
Sand (S)	1.815	1.979	1.831	1.875	0.110	0.127	0.178	0.138	1.33	1.56	1.55	1.48
S + 25 % clay	1.962	2.173	1.976	2.025	0.131	0.149	0.158	0.146	1.51	1.78	1.65	1.65
S + 25 % FYM	2.283	2.491	2.179	2.318	0.147	0.163	0.173	0.161	1.74	2.05	1.83	1.87
Mean	2.020	2.214	1.995		0.129	0.146	0.170		1.53	1.80	1.68	

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الملخص العربي

استجابة نباتات البرواليا والتيفتيا الصفراء لبعض بيئات النمو ومعاملات التسميد

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لكي نحصل على أعلى قيمة تنسيقية لنباتات البرواليا (*Browallia speciosa* Hook.) والتيفتيا الصفراء (*Thevetia peruviana* (Pers.) K. Schum.) عند استخدامها كنباتات أصص، كان من الضروري تحديد أفضل بيئة ومعاملة سمادية للحصول على أفضل نمو. لذلك أجريت هذه الدراسة بمكان نصف مظلّل بمشتل حديقة الأورمان النباتية، معهد بحوث البساتين، الجيزة، مصر خلال موسمي ٢٠١٦، ٢٠١٧ حيث زرعت شتلات عمر سنة من هذين النباتين في أصص بلاستيك قطرها ٢٠ سم، ملأت بحوالي ٣,٥ كجم من أحد بيئات النمو التالية: رمل فقط (كمقارنة) أو رمل مخلوط بـ ٢٥ % (٣:١، v/v) من الطين أو سمد مخلفات المزرعة (FYM). بعد أسبوعين من الشتل، تلقت الشتلات ثلاث معاملات من التسميد كآلاتي: التسميد بسلفات الأمونيوم [(٤يد)٢كـب ٤، ٢٠,٥ % أزوت)] بمعدل ٢ جم/نبات كمعاملة سمادية موصى بها أضيفت شهرياً، تكييفاً للتربة، خمس مرات أو التسميد بنوعين من سمد البوتاسين السائل [بوتاسين - (يحتوي على ٣٠ % بوتاسين، ٨ % أزوت) أو بوتاسين - (يحتوي على ٣٠ % بوتاسين، ١٠ % فوسفات) ٥] والتي أضيفت شهرياً، خمس مرات، رشاً على الأوراق بتركيز ٢ مل/لتر لكل نوع على حدة. تم أيضاً دراسة تأثير المعاملات المشتركة بين نوع بيئة النمو ومعاملات التسميد الثلاثة لتحديد أفضل معاملة بيئية سمادية لنمو هذين النباتين في أصص.

أوضحت نتائج هذه الدراسة أن متوسطات جميع صفات النمو الحضري والجزري (طول النبات، قطر الساق، عدد الأوراق/نبات، طول الجذر وكذلك الأوزان الطازجة والجافة للأوراق والجذور) لكلا النباتين موضع الدراسة قد زادت معنوياً استجابة لدعم بيئة الرمل بـ ٢٥ % من الطين أو سمد مخلفات المزرعة وكذلك للتسميد بنوعي البوتاسين المستخدمين بهذه الدراسة، مع تفوق بيئة النمو المكونة من الرمل + ٢٥ % سمد مخلفات المزرعة ومعاملة التسميد بالبوتاسين - (٢ مل/لتر) والتي أعطيت أعلى القيم على الإطلاق بكلا الموسمين. لذلك، فإن أكبر معدلات للنمو في كلا النباتين تحققتا بالزراعة في مخلوط الرمل + ٢٥ % سمد مخلفات المزرعة والتسميد بالبوتاسين - (٢ مل/لتر) رشاً على الأوراق بمعدل ٢ مل/لتر. ولقد تم الحصول أيضاً على اتجاه مشابه لنتائج النمو الحضري والجزري فيما يتعلق بمحتوى الأوراق من كلوروفيل أ، ب، الكاروتينويدات، النيتروجين، الفوسفور والبوتاسيوم مع بعض الاستثناءات البسيطة.

طبقاً لهذه النتائج، يمكن التوصية بزراعة الشتلات عمر سنة لنبات البرواليا والتيفتيا الصفراء في مخلوط نمو مكون من الرمل + ٢٥ % سمد مخلفات المزرعة، مع رش أوراقهما بالمحلول المائي لسمد البوتاسين - (٢ مل/لتر)، خمس مرات بفاصل شهر بين كل مرتين للحصول على نباتات أصص نموذجية، عالية الجودة، صالحة للتسويق التجاري.