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Growth and Flowering Affection of *Ranunculus asiaticus* L. Var. "Orange" Plant by Media and Irrigation Water Amounts

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Abstract: Two pot experiments were undertaken during 2019/20 and 2020/21 seasons at the nursery of Hort. Res. Inst., Giza, Egypt to study the effect of different growing media: Sand (S), S + Cairopeat compost (CP), S + Bokashi compost (Bo.), S + Nile compost (NC) and S + CP + Bo.+ NC (at equal volumes), under water amounts of 100, 150 and 200 ml/pot (10 cm diameter) and their interactions on growth, flowering and leaf chemical composition of *Ranunculus asiaticus* L. var. "Orange", as flowering pot plant. The results showed that sand + Nile compost medium gave the highest number of leaves, leaves fresh and dry weights, least number of days to flowering, highest number of flowers, longest flower stalk, widest flower diameter, heaviest flower fresh and dry weights and followed by sand standalone that gave means either close to or higher than the previous one. An identical response was also obtained concerning number of tuberous roots and their fresh and dry weights. Water amount of 150 ml/pot recorded better results than 200 ml/pot level in most characters mentioned before, whereas 100 ml/pot treatment acquired the least effect. So, combining between planting in sand + Nile compost medium and irrigating with 150 ml/pot scored in most instances better results compared to the other combinations. Concentrations of some active constituents in the leaves as affected by various sole or combined treatments used in this study were fluctuated without a clear trend with few exceptions in both seasons. Hence, it can be proposed to plant *Ranunculus asiaticus* L. var. "Orange" tubers in a mixture of sand + Nile compost (1:1, v/v) and irrigate them with 150 ml of fresh water per pot (10-cm-diameter) to attain the best growth, flowering and tuber production.

Key words: Crowfoot · *Ranunculus* · Media · Water quantity · Tuber · Flowering pot plants

INTRODUCTION

Production of flowering pot plants becomes now very essential to face the excess demands for such type of plants locally and abroad. Among plants that can be used for this purpose is *Ranunculus asiaticus* L. (Fam. Ranunculaceae), which known as Buttercup (due to flower shape), Crowfoot (because its tuberous roots greatly like the red crowfoot) or Persian and Turban ranunculus (it natives to Iran, Turkey and Asia Minor). It is hardy perennial herb, 8-18 inch tall with erect, simple or branched, somewhat appressed hirsute stems and lobed, deeply cut, somewhat glaucous leaves. Their showy flowers are terminal, may be red, pink, salmon, orange, white or yellow, cup shaped, to 2 inch wide with purple-black center or solid, normally single but double forms are much grown and flower at late spring. Cultivated in garden borders, sometime in the greenhouse, double forms are good cut flowers, for bedding schemes and as pot plants [1, 2].

The roots of plants grown in pots are restricted by pot size and the volume of medium. Therefore, they require a good selection for their medium components and water quantity necessary for optimum growth and development. This truth was emphasized by Shahin *et al.* [3] who found that planting of *Agave americana* cv. Marginata small suckers in 15-cm-diameter pots filled with 1.5 kg of sand + 10 % loam amended with 10 % chicken manure compost and irrigating with 150 ml of fresh water/pot every other day gave the best vegetative and root growth, highest production and quality of suckers with the highest water use efficiency. Similar findings, were reported by Dwi and Treder [4] on lily, Awang *et al.* [5] on *Celosia cristata*, Shahin *et al.* [6] on tuberose,

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Van Iersel *et al.* [7] on petunia, Ali [8] on dahlia, marigold, zinnia and cosmos, O`Meara *et al.* [9] on gardenia and hydrangea, Sardoei and Rahbarian [10] on *Ficus benjamina*, Said [11] on *Duranta erecta*, Panupon and Soraya [12] on petunia, Gohil *et al.* [13] on aglaonema, anthurium, diffenbachia, chrysanthemum and gerbera, Rydlova and Puschel [14] on *Gazania rigens*, *Pelargonium peltatum* and *P. zonale* and El-Fouly *et al.* [15] on *Asparagus densiflorus* "Myers".

The goal of such work, however is determining the most suitable medium ingredients and water amount needed for better growth and flowering of Buttercup (Crowfoot) plant when using it as a pot plant.

MATERIALS AND METHODS

A pot experiment was carried out under semi-shade area at the nursery of Hort. Res. Inst., Giza, Egypt throughout 2019/20 and 2020/21 seasons to find out the optimum water amount and the best medium components reliable for growing *Ranunculus asiaticus* L. var. "Orange" plant when produce as pot plant.

So, the whole tubers of such plant (each one contains about 14-16 tuberous roots "claws" and weighed about 1.8-2.0 g) were planted about 5 cm in depth on November, 15th for every season in 10-cm-diameter plastic pots filled with one of the following media 1 cm below the rim: sand (S) as control, S + Cairopeat (CP), as a natural organic soil conditioner, S + Bokashi (Bo) as a natural peat prepared from plant wastes, S + Nile compost (NC) and S + CP + Bo.+ NC mixture. The previous mixtures prepared at equal volumetric parts and mixed well before filling the pots. Some physical and chemical properties of the sand used in both seasons are shown in Table (a), whereas those of the used organic materials are listed in Table (b).

Immediately after planting, all pots were irrigated with 250 ml of fresh water/pot, but after 2 days they were received the following amounts of fresh water: 100, 150 and 200 ml/pot till the end of experiment on (April, 15th). Both media and water treatments were combined factorially to form 15 interactions. Irrigation was done once every 2 days and the chemical fertilizer (19:19:19 + microelements) was added at 1 g/pot, once every 3 weeks

Table a: Some physical and chemical properties of the sand used in the two studied seasons

	Practical size distribution (%):							Cations (meq/L)				Anions (Meq/L)		
Season	Coarse sand	Fine sand	Silt	Clay	S.P.	E.C. (dS/m)	pH	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}
2019/20	85.31	5.36	1.37	7.96	22.31	2.85	7.9	8.34	1.76	23.51	0.97	3.31	21.53	9.74
2020/21	73.50	17.48	0.99	8.03	21.39	2.39	7.9	11.58	9.50	10.35	0.75	3.00	16.81	12.37

Table b: Some physical and chemical properties of the organic materials used in the two studied seasons

Character	Cairo peat	Bokashi	Nile compost
Weight of m^3 (kg)	370.5	440.7	550.5
Humidity (%)	14.85	33.31	55.60
Organic matter (%)	43.50	42.90	47.70
Organic carbon (%)	22.49	23.17	27.3
C/N ratio	10.35/1	15.51/1	17.50/1
pH (1:10)	4.5-5.5	4.5-6.0	6.0
EC (dS/m)	0.7-1.3	0.7-1.1	1.0-1.5
Water retention (%)	400	200	100
Macro-elements (%)			
N	2.60	2.40	3.00
P_2O_5	0.55	0.48	0.50
K_2O	2.39	1.63	2.50
$CaCO_3$	1.60	1.44	1.60
MgO	0.90	0.85	0.96
Micro-elements (ppm)			
Fe	200	320	1240
Mn	15.6	25	324
Zn	14.50	18.7	33.5
Cu	5.3	6.6	31.6

during the course of study. A plastic sheet was hung over the pots at 2m height to protect them from the rains. A factorial experiment based on a complete randomized design, replicated thrice with five plants/replicate was accomplished in the two seasons [16].

The growth and flowering data were recorded in time as follows: number of leaves/plant, fresh and dry weights of the leaves (g), number of days elapsing from planting to first flower open, number of flowers/plant, flowering stalk length (cm), flower diameter (cm) and flower fresh and dry weights (g). At the end of each season (on April, 15th), the plants were gently lifted to count number of tuberous roots/plant and determine their fresh and dry weights (g). In fresh leaf samples, concentration of photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) was measured using the method of Sumantha *et al*., [17]. The percentages of total carbohydrates, nitrogen, phosphorus and potassium were evaluated according to the methods described by Herbert *et al*., [18]; Blacke [19]; John [20] and Page *et al*., [21] respectively.

Data were then tabulated and statistically analyzed using the Assistant Software of Silva and Azevedo [22], followed by Duncan`s New Multiple Range t-Test Steel and Torrie, [23] to reveal the significancy among means of various treatments.

RESULTS AND DISCUSSION

Effect of Medium, Water Amount and Their Interactions on Number of Leaves and Their Fresh and Dry Weights: It is obvious from data averaged in Table (1) that sand amended with Nile compost medium scored the highest number of leaves and the heaviest leaf fresh and dry weights (g) compared to all the other media in the two seasons, followed by the sand standalone. This may be ascribed to that Nile compost contains higher organic matter that makes as food reservoir and higher macro-and micro-elements than other amendments used in this study (Table, b). Thus, Nile compost supplies the plants during various growth stages with sufficient nutrients necessary for good growth. Water amount of 150 ml/pot gave also the best results of leaf characters relative to 100 ml/pot treatment, whereas rising this amount to 200 ml/pot don`t cause any extra in the means of previous traits giving less records than 150 ml treatment. This affirms that excessive water doesn't always lead to more growth, but the suitable water amount may prevent ABA synthesis which reduces root growth, induces defoliation and finally inhibits plant growth Hoffman *et al*. [24]. In this regard, Said [11] found that combining between planting in sand amended with poultry manure compost (2:1, v/v) medium and irrigating with 300 ml of water/plant of *Duranta erecta* var. Variegata gave the highest values of plant height, stem diameter, number of branches and leaves, leaf area, root length and fresh and dry weights of stem, leaves and roots. On *Asparagus densiflorus* "Myers", El-Fouly *et al*. [15] revealed that amending the sand with either cocopeat or cocopeat + vermiculite and irrigating with 150 or 200 ml of water/plant significantly reduced the water amount necessary for producing 1 g of dry matter to the minimum. In addition, Rydlova and Puschel [14] mentioned that severe drought decreased shoot and root biomass of *Gazania rigens* and *Pelargoium zonale*, but it had no effect on those of *Pelargonium peltatum*.

It was also noticed that interaction treatments had a pronounced effect on leaf parameters, where combining between planting in sand + Nile compost medium (1:1, v/v) and any volume of water acquired the highest values in most cases of both seasons, but the superiority was for planting in this medium and irrigating with 150 ml/pot rate combination which gave the utmost high means over all the other combinations in most instances of the two seasons. This may be attributed to lump the beneficial effects of both Nile compost as a natural and sustainable source of luxurious nutrients and the proper water amount necessary for promoting vital processes, increasing auxins and gibberellins level simultaneously with reducing ABA level which might activate meristems and encourage cell division [25]. In general, the medium of sand + CP + Bo. + NC induced the least improvement in leaf growth under the different water amounts, with few exceptions in both seasons. The previous gains, however are in accordance with those suggested by Dwi and Treder [4] on oriental lily "Star Gazer:, Awang *et al*. [5] on *Celosia cristata*, Van Iersel *et al*. [7] on *Petunia x hybrid*, Ali, [8] on dahlia, marigold, zinnia and cosmos, Panupon and Soraya [12] on "Coral Pink Wave" petunia. Gohil *et al*. [13] mentioned that potting media containing sand + cocopeat + vermicompost (2:1:1, v/v/v) resulted in best growth performance and quality of aglaonema pot plant, whereas amending the soil with rice husk compost (1:1, v/v) exerted maximum number of sprouts/plant in potted dieffenbachia for house beautification.

Table 1: Effect of medium, water amount and their interactions on leaves traits of *Ranunculus asiaticus* L. var. "Orange" plant during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)											
	100	150	200		100	150	200		100	150	200	
Medium	No. leaves/plant			Mean	Leaves fresh weight (g)			Mean	Leaves dry weight (g)			Mean
	First season; 2019/2020											
Sand (S)	23.42f	32.50b	29.00c	28.31B	7.63d	10.21b	8.63c	8.82B	1.89ef	3.25bc	2.87d	2.67B
S + Cairopeat compost (CP)	18.75h	34.27a	19.50g	24.17C	6.33e	10.38b	7.37d	8.03B	1.36g	3.10c	1.50f	1.99D
S + Bokashi compost (Bo.)	25.30e	29.25c	18.76h	24.44C	6.50e	8.33c	6.48e	7.10C	1.58f	2.67de	1.38fg	1.88D
S + Nile compost (NC)	24.25e	33.36a	32.00b	29.87A	8.32c	17.40a	10.99b	12.24A	2.15e	5.61a	3.35b	3.70A
S + CP + Bo.+ NC	17.50i	20.00g	27.16d	21.55D	6.90e	8.87c	7.31d	7.69C	1.35g	2.76de	2.15e	2.09C
Mean	21.84C	29.88A	25.28B		7.14C	11.04A	8.16B		1.67C	3.48a	2.25B	
	Second season; 2020/2021											
Sand (S)	25.17f	33.76b	30.21c	29.71A	6.87f	10.31c	10.11c	9.10B	2.15gh	3.89c	3.10d	3.05B
S + Cairopeat compost (CP)	20.30h	35.10a	22.38g	25.93B	6.50f	10.72c	7.45e	8.22C	2.39g	3.75c	2.80f	2.98C
S + Bokashi compost (Bo.)	26.19e	30.41c	23.00g	26.53B	6.67f	9.13d	6.38f	7.39D	1.97h	2.96e	2.89e	2.62C
S + Nile compost (NC)	25.20f	34.11a	30.53c	29.95A	7.63e	18.33a	11.45b	12.47A	2.78f	5.89a	3.92b	4.20A
S + CP + Bo.+ NC	19.33i	29.36d	22.71g	23.80C	7.22e	9.46d	8.10de	8.26C	1.39i	3.15d	2.68f	2.41D
Mean	23.24C	32.55A	25.77B		6.98C	11.59A	8.70B		2.14C	3.93A	3.08B	

Means having similar letters within a column or row are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level

Table 2a: Effect of medium, water amount and their interaction on some flowering traits of *Ranunculus asiaticus* L. var. "Orange" plant during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)											
	100	150	200		100	150	200		100	150	200	
Medium	No. days to flowering (day)			Mean	No. flowers/plant			Mean	Flowering stalk length (cm)			Mean
	First season; 2019/2020											
Sand (S)	125.6c	117.9f	117.4f	120.3D	1.76d	3.25b	2.33b	2.45B	18.51i	29.70b	27.75c	25.32B
S + Cairopeat compost (CP)	126.3c	120.5e	123.5d	123.4C	1.76d	2.75c	2.71c	2.41B	18.73i	29.41b	23.00f	23.71C
S + Bokashi compost (Bo.)	125.7c	119.3e	131.5a	125.5B	1.83d	2.33c	2.40c	2.19B	20.25h	21.76g	26.10d	22.70C
S + Nile compost (NC)	131.8a	117.5f	118.3e	122.5C	2.85bc	5.76a	5.25a	4.62A	24.10e	31.56a	32.63a	29.43A
S + CP + Bo.+ NC	132.0a	129.1b	132.3a	131.1A	1.25e	1.75d	2.33c	1.78C	15.33j	23.38f	24.91de	21.21D
Mean	128.3A	120.9C	124.6B		1.89B	3.17A	3.01AB		19.38B	27.16A	26.88A	
	Second season; 2020/2021											
Sand (S)	127.2c	120.0f	119.3f	122.2C	2.50d	3.60b	3.76b	3.29B	22.31g	31.40a	29.21b	27.64B
S + Cairopeat compost (CP)	128.5c	122.4e	125.0d	125.3B	1.75e	3.00c	3.00c	2.58C	23.50f	24.33e	21.50h	23.11C
S + Bokashi compost (Bo.)	114.3g	121.5e	128.4c	121.4C	2.33d	2.67cd	2.58cd	2.53C	23.00f	23.50f	28.11c	24.87C
S + Nile compost (NC)	127.2c	118.5fg	115.0g	120.2D	3.00c	5.28a	5.80a	4.69A	26.12d	31.50a	31.98a	29.87A
S + CP + Bo.+ NC	134.7a	131.2b	135.5a	133.8A	1.76e	2.00de	3.00c	2.25D	14.10i	24.36e	25.10de	21.19D
Mean	126.4A	122.7C	124.7B		2.25B	3.31AB	3.63A		21.81B	27.02A	27.18A	

Means having similar letters within a column or row are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level

Effect of Medium, Water Amount and Their Interactions on Flowering Characteristics: A similar trend to that of leaf characters was also obtained in relation to flowering response (Tables 2 a and b), where both sand + Nile compost and sand alone media significantly advanced flowering and recorded the highest number of flowers/plant, longest flowering stalk (cm), widest flowers (cm) and heaviest flower fresh and dry weights (g) comparing with the other growing media in the two seasons. However, the dominance in these criteria was for sand + Nile compost medium that raised the means of the aforementioned parameters (except of number of days elapsed to flowering) to maximal values in both seasons. This may be reasonable because Nile compost provides the plants with enough elements that improving growth and accelerating flowering. The water quantities of either 150 or 200 ml/pot, as well hastened flowering speed and traits and were statistically at par with each other with

Table 2b: Effect of medium, water amount and their interaction on some flowering traits of *Ranunculus asiaticus* L. var. "Orange" plant during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)											
	100	150	200		100	150	200		100	150	200	
Medium	Flower diameter (cm)			Mean	Flower fresh weight (g)			Mean	Flower dry weight (g)			Mean
	First season; 2019/2020											
Sand (S)	4.10ef	5.09a	4.31de	4.50B	2.11f	3.07c	2.50e	2.56B	0.73d	0.81c	0.76d	0.77B
S + Cairopeat compost (CP)	4.46d	4.50d	3.50g	4.15C	2.00f	2.82d	2.10f	2.31C	0.61e	0.80c	0.66e	0.69B
S + Bokashi compost (Bo.)	3.87f	4.80c	4.76cd	4.48BC	2.31ef	3.00c	2.41e	2.57B	0.74d	0.83c	0.75d	0.77B
S + Nile compost (NC)	4.90b	5.21a	4.88b	5.00A	3.08c	4.10a	3.62b	3.60A	1.03b	1.25a	1.10ab	1.13A
S + CP + Bo.+ NC	3.85f	4.27e	4.63cd	4.25C	1.35g	2.37e	2.26ef	1.99D	0.43f	0.86c	0.83c	0.71B
Mean	4.24B	4.78A	4.42AB		2.17C	3.07A	2.58B		0.71B	0.91A	0.82AB	
	Second season; 2020/2021											
Sand (S)	4.30de	5.20a	4.25e	4.58C	2.76e	3.10d	3.51c	3.12B	0.79ef	0.82e	1.05c	0.89B
S + Cairopeat compost (CP)	3.26f	4.63c	4.45d	4.11D	2.42fg	2.56f	3.33cd	2.77C	0.67g	0.71f	0.90d	0.76C
S + Bokashi compost (Bo.)	4.12e	5.00ab	4.98ab	4.70B	2.75e	2.91de	2.79e	2.82C	0.77ef	0.80e	0.78ef	0.78C
S + Nile compost (NC)	4.56c	5.13a	5.10a	4.93A	2.58f	4.50a	4.10b	3.73A	1.12bc	1.30a	1.18b	1.20A
S + CP + Bo.+ NC	4.10e	4.43d	4.81b	4.45C	2.17g	2.97de	3.11d	2.75C	0.53h	0.79ef	0.96d	0.76C
Mean	4.07B	4.88A	4.72AB		2.54B	3.21A	3.37A		0.78B	0.89A	0.98A	

Means having similar letters within a column or row are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level

Table 3: Effect of medium, water amount and their interaction on tuberous roots traits of Ranunculus asiaticus L. var. "Orange" plant during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)											
	100	150	200		100	150	200		100	150	200	
Medium	No. tuberous roots/plant			Mean	Tuberous roots fresh weight (g)			Mean	Tuberous roots dry weight (g)			Mean
	First season; 2019/2020											
Sand (S)	13.00i	15.76f	17.70e	15.49c	3.35gh	5.34d	4.27e	4.32b	1.33c	1.75b	1.58b	1.55b
S + Cairopeat compost (CP)	11.50j	13.54h	14.50g	13.18d	3.90f	3.98f	3.40g	3.76c	1.67b	1.70b	1.34c	1.57b
S + Bokashi compost (Bo.)	11.76j	15.23f	13.33h	13.44d	3.35gh	3.78f	2.73f	3.29d	1.34c	1.69b	1.46bc	1.50c
S + Nile compost (NC)	13.95gh	20.75c	18.30d	17.67b	4.18e	7.67a	6.20b	6.02a	1.29cd	2.15a	1.96a	1.80a
S + CP + Bo.+ NC	25.32b	29.10a	19.84c	24.75a	3.25h	5.88c	3.61g	4.25b	1.25cd	1.98a	1.17d	1.47c
Mean	15.11c	18.88a	16.73b		3.61c	5.33a	4.04b		1.38c	1.86a	1.50b	
	Second season; 2020/2021											
Sand (S)	11.75g	13.46f	17.63d	14.28c	3.50f	5.81c	4.72d	4.68b	1.45d	1.89b	1.64c	1.66b
S + Cairopeat compost (CP)	9.50i	10.50h	11.52g	10.51d	4.00e	4.50d	3.78e	4.09c	1.35e	1.82bc	1.56cd	1.58c
S + Bokashi compost (Bo.)	9.87i	11.38gh	10.36hi	10.54d	3.75e	4.00e	3.09g	3.61d	1.31e	1.58cd	1.40de	1.43c
S + Nile compost (NC)	17.52d	18.50c	16.76e	17.59b	4.50d	7.88a	6.45b	6.28a	1.47d	2.15a	2.30a	1.97a
S + CP + Bo.+ NC	26.10a	22.11b	17.96cd	22.06a	3.61ef	6.58b	3.90e	4.70b	1.43d	2.10ab	1.65c	1.73b
Mean	14.95b	15.19a	14.85b		3.87c	5.76a	4.39b		1.40c	1.91a	1.71b	

Means having similar letters within a column or row are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level

non-significant differences among them in most cases, of both seasons. Growing ranunculus plants in either sand alone or sand + Nile compost media and watered with either 150 or 200 ml/pot rate significantly reduced number of days to flowering to the minimum relative to the other combinations, causing of precocious flowering in both seasons, but the upper hand was found due to planting in sand fortified with Nile compost and irrigating with 150 ml/pot level, which also attained the greatest averages of number of flowers, length of flowering stalk, flower diameter and its fresh and dry weights over all the other interactions, with few exceptions in the two seasons.

These results could be discussed and interpreted as done before in case of leaf parameters and they are consistent with the reports mentioned by Awang *et al*. [5] on *Celesia cristata*, Panupon and Soraya [12] on "Coral Pink Wave) petunia hybrid, Gohil *et al*. [13] on chrysanthemum, gerbera, anthurium, orchid and zinnia.

In this concern, Dwi and Treder [4] noticed that Oriental lily grown in organic compost medium flowered earlier, had higher fresh and dry weights of flowers, had longer flower buds and lower bulb depletion between planting and flowering.

Effect of Medium, Water Amount and Their Interactions on Tuberous Roots Productivity: A parallel response to that of leaf and flowering attributes occurred as well in respect of tuberous roots production (Table 3), where sand plus Nile compost medium surpassed all the other media scoring the highest number and fresh and dry weights (g) of tuberous roots in the two seasons, except of number of tuberous roots character that reached the maximum by planting in sand + CP + Bo. + NC medium, which resulted 24.75 tuberous roots in the first season and 22.06 tuberous roots in the second one against 17.67 and 17.59 produced in both seasons, respectively by the super medium (sand + NC). The water volume of 150 ml/pot, also attained the greatest records in both seasons and followed by 200 ml/pot treatment. The interaction effects were fluctuated, but connecting between planting in sand + Nile compost medium and watering with either 150 or 200 ml/ pot gave better results than other interactions in most cases of the two seasons.

The aforementioned findings may indicate the improvement effect of both good quality of medium ingredients and the proper supply of water on providing the adventitious buds with the required water, minerals and aeration needed for creating more and heaviest tubers. On the same line, were those results of Sardoei and Rahbarian [10] on *Ficus benjamina*, *Pandanus sanderi* and *Rosmarinus officinalis*, Said [11] on *Duranta erecta* var. Variegata and El-Fouly *et al*. [15] on *Asparagus densiflorus* "Myers".

Effect of Medium, Water Amount and Their Interactions on Chemical Composition of the Leaves: Data of leaf chemical composition listed in Tables (4 and 5) exhibited that concentrations of chlorophyll a, b and carotenoids (mg/g f.w.), as well as the percentages of total carbohydrates, nitrogen, phosphorus and potassium were unsteady without a clear trend in its response to the different treatments and interactions used in this study in both seasons, except for water amounts of 150 and 200 ml/pot treatments, which gave values of the previous constituents closely near together and markedly higher than those acquired by the rate of 100 ml/pot. In addition, the medium of sand + CP + Bo. + NC recorded the highest concentration of chlorophyll a, but gave the least concentrations of chlorophyll b, total carbohydrates, N, P and K compared to the other media, even the sand alone in the two seasons. It is also noticed that plants grown in sand + Cairopeat compost medium were, to some extent pale due to the clear reduction of pigments in their leaves relative to the other medium the first and second seasons.

These results, however can be supported by those discovered by Said [11] on *Duranta erecta* var. Variegata and El-Fouly *et al*. [15] who found that pigments, total carbohydrates, N, P and K in the leaves of *Asparagus densiflorus* "Myers" were maximum in response to amending the sand with either cocopeat or cocopeat + vermiculite plus irrigation with either 150 or 200 ml of water/plant.

Table 4: Effect of medium, water amount and their interaction on pigments concentration in *Ranunculus asiaticus* L. var. "Orange" leaves during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)											
	100	150	200		100	150	200		100	150	200	
Medium	Chlorophyll a (mg/g f.w.)			Mean	Chlorophyll b (mg/g f.w.)			Mean	Carotenoids (mg/g f.w.)			Mean
	First season; 2019/2020											
Sand (S)	0.298	0.425	0.530	0.418	0.100	0.144	0.192	0.145	0.149	0.225	0.262	0.212
S + Cairopeat compost (CP)	0.269	0.337	0.450	0.352	0.119	0.154	0.136	0.136	0.150	0.154	0.198	0.167
S + Bokashi compost (Bo.)	0.380	0.562	0.411	0.451	0.175	0.185	0.181	0.180	0.197	0.235	0.200	0.211
S + Nile compost (NC)	0.371	0.501	0.473	0.448	0.114	0.180	0.149	0.148	0.165	0.208	0.178	0.184
S + CP + Bo.+ NC	0.343	0.540	0.580	0.488	0.100	0.120	0.136	0.119	0.138	0.187	0.203	0.176
Mean	0.332	0.473	0.489		0.122	0.157	0.159		0.160	0.202	0.208	
	Second season; 2020/2021											
Sand (S)	0.315	0.438	0.486	0.413	0.104	0.185	0.205	0.165	0.151	0.254	0.305	0.237
S + Cairopeat compost (CP)	0.291	0.376	0.489	0.385	0.110	0.138	0.167	0.138	0.203	0.216	0.246	0.222
S + Bokashi compost (Bo.)	0.412	0.479	0.450	0.447	0.190	0.197	0.173	0.187	0.211	0.253	0.243	0.236
S + Nile compost (NC)	0.408	0.531	0.396	0.445	0.152	0.199	0.172	0.174	0.273	0.286	0.230	0.263
S + CP + Bo.+ NC	0.411	0.628	0.641	0.560	0.113	0.142	0.181	0.145	0.179	0.239	0.251	0.223
Mean	0.367	0.490	0.492		0.134	0.172	0.180		0.203	0.250	0.255	

Table 5: Effect of medium, water amount and their interaction on total carbohydrates, nitrogen, phosphorus and potassium concentrations in *Ranunculus asiaticus* L. var. "Orange" leaves during 2019/20 and 2020/21 seasons

	Water amount (ml/pot)															
	100	150	200		100	150	200		100	150	200		100	150	200	
Medium	Total carbohydrates (%)			Mean	Nitrogen (%)			Mean	Phosphorus (%)			Mean	Potassium (%)			Mean
	First season; 2019/2020															
Sand (S)	21.72	31.65	32.00	28.46	1.57	2.58	1.79	1.98	0.389	0.233	0.175	0.266	1.45	1.55	1.43	1.48
S + Cairopeat compost (CP)	23.54	29.58	38.10	30.41	1.99	2.43	2.21	2.21	0.249	0.459	0.158	0.289	1.49	1.65	1.46	1.53
S + Bokashi compost (Bo.)	27.45	34.69	29.24	30.46	1.71	2.88	2.29	2.29	0.233	0.231	0.217	0.227	1.31	1.52	1.47	1.43
S + Nile compost (NC)	22.76	31.33	31.50	28.53	1.78	2.89	2.30	2.32	0.241	0.246	0.199	0.229	1.36	1.49	1.65	1.50
S + CP + Bo.+ NC	19.35	21.73	22.91	21.33	1.39	1.67	1.43	1.50	0.176	0.155	0.118	0.150	1.27	1.38	1.50	1.38
Mean	22.96	29.80	30.75		1.69	2.49	2.00		0.258	0.265	0.173		1.38	1.52	1.50	
	Second season; 2020/2021															
Sand (S)	22.40	32.38	26.90	27.36	2.21	3.10	2.45	2.59	0.430	0.351	0.233	0.338	1.61	1.70	1.58	1.63
S + Cairopeat compost (CP)	24.81	30.89	31.10	28.93	2.39	2.86	2.67	2.64	0.261	0.490	0.321	0.357	1.66	1.79	1.62	1.69
S + Bokashi compost (Bo.)	28.23	29.50	35.00	30.91	2.10	3.00	2.69	2.60	0.283	0.271	0.300	0.285	1.48	1.68	1.63	1.60
S + Nile compost (NC)	23.76	32.66	32.81	29.51	2.50	3.22	2.81	2.84	0.250	0.321	0.310	0.294	1.73	1.70	1.51	1.65
S + CP + Bo.+ NC	21.50	23.38	24.50	23.13	1.87	2.23	1.99	2.03	0.220	0.250	0.243	0.238	1.38	1.53	1.64	1.52
Mean	24.14	29.84	29.92		2.21	2.88	2.52		0.289	0.337	0.281		1.57	1.68	1.60	

According to the previous findings, it can be advised to planting *Ranunculus asiaticus* L. var. "Orange" tubers in sand amended with Nile compost at equal volumetric parts for each and irrigating them with 150 ml/ pot (10-cm-diameter) fresh water when produced as flowering pot plant.

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