Journal of Ornamental Plants
www.jornamental.iaurasht.ac.ir
ISSN (Print): 2251-6433 ISSN (Online): 2251-6441
Research Paper
Volume 12, Number 1: 11-29, March, 2022
DOR: https://dorl.net/dor/20.1001.1.22516433.2022.12.1.3.7

The Possibility of Replacing the Cocopeat by Palm Substrate to the Soilless Culture of Lily

Sajad Heidari[1*], Seyed Najmmaddin Mortazavi1, Saeid Reezi[2], and Ali Nikbakht[3]

[1] Department of Horticultural Sciences, Faculty of Agriculture, University of Zanjan, Zanjan, Iran
[2] Department of Horticultural Sciences, Faculty of Agriculture, Shahrekord University, Shahrekord, Iran
[3] Department of Horticultural Sciences, Faculty of Agriculture, Isfahan University of Technology, Isfahan, Iran
Received: 22 June 2021 Accepted: 17 August 2021

*Corresponding author's email: heidari.sajad@znu.ac.ir

Abstract

The quality and quantity of lily cut flowers depend mostly on the composition of growing media. To evaluate the effect of two sources of the palm peat substrate (the palm trunk: Prepared from the trunk of the date palm; the palm tree: Prepared from all parts of the date palm) on plant growth traits related to cut lily flower, a factorial experiment arranged in a completely randomized design with three replications. The impact of eleven root growing media consisted of mixtures of palm peat, cocopeat, and perlite on two cultivars ('Tiber' and 'Candy Club') were evaluated under hydroponic conditions. The results showed that the stem diameter, the time of flower emergence, buds length, leaves relative water content (LRWC), leaves and petal's electrolyte leakage (LEL and PEL), bud visual quality, and quality index criteria were as more in the 'Candy Club', but SPAD1 and bud diameter characters were higher in the 'Tiber'. The highest amount of chlorophyll a, b, and total, SPAD1, SPAD3, stem diameter, bud diameter, and quality index were observed in control (80% cocopeat + 20% perlite), which was not significantly different from some palm trunk, and reused cocopeat substrates. The higher value of LRWC, bud length, and carotenoid was observed in 20% palm trunk treatment, while the higher flower longevity occurred in 60% palm tree treatment. 80% reused cocopeat treatment was showed the highest number of bulblets, SPAD2, and time to harvest. The lowest amount of LEL, harvest time, and time of flower emergence was observed in the control. Various cultivars differently respond to growing media, and palm trunk and reused cocopeat could replace a part and, or whole of expensive imported cocopeat. The palm trunk substrates were superior to the palm tree substrates, but there was a low advantage of control than the palm trunk substrate.

Keywords: Bulb, Flower longevity, Greenhouse, Growing media, *Lilium*.

INTRODUCTION

One-third of ornamental plants' economy belongs to cutting flowers (Datta *et al*., 2013). Lily (*Lilium* spp.) is one of the bulbous flowering plants known for its significant and attractive flowers (Le Nard and De Hertogh, 1993; Hajizadeh, 2016). Lily is one of the six significant genera of bulbous flowers globally (Malik, 2014). This plant produces many colorful flowers that are very popular and expensive (Hassanpour Asil, 2008). Also, it is ranked fourth after roses, cloves, and chrysanthemum, which are the most famous plants in the world (Kafi and Ghahsareh, 2009; Mohammadi Torkashvand and Seyedi, 2016). In terms of production, this plant is ranked second in the world of production (Wani *et al*., 2016). In the flower production process of lily, flower quality, which contains the color of the flower, flower size, stem length, and diameter, and flower longevity, are very important (Burchi *et al*., 2010). The longevity of the flowers is affected by some pre and postharvest factors in which cultivar, Application of plant nutritional elements, and growing media are the pre-harvest factors (Khalaj, 2005). Plant growth conditions affect the quality of cut flowers (Al-Ajlouni *et al*., 2017) so, providing appropriate environmental and nutritional needs before harvesting of flowers could positively impact the quality and longevity of the flowers. In recent years, the greenhouse cultivation and off-season production of crops in different growing media has expanded because of better control for plant nourishing and the increase of quality and quantity of products. Growing media, directly and indirectly, affects plant growth and productivity, and it is also one of the main factors in the success of soilless cultures (Doaguie and Ghazanfari Moghadam, 2015). Lily's growing media should have good aeration, water holding capacity, drainage, and physical structure. In heavy soils without adequate drainage, the development of the root system is diminished, and the plants become more susceptible to soil diseases (Treder, 2008). Growers traditionally use field soils as the growing media, since it is relatively inexpensive compared to artificial substrates such as peat, perlite, or cocopeat. However, Producers who do not have access to suitable soils, typically use peat moss and cocopeat (Merhaut and Newman, 2005). Cocopeat or coconut fiber soil is among the most abundant substrates in tropical regions (Abad *et al*., 2002; Awang *et al*., 2009, 2010). According to its availability and benefit, most ornamental plant producers in tropical regions use it in growing media as the primary substrate (Abad *et al*., 2002; Awang *et al*., 2009). Since cocopeat is achieved from coconut trees, its industrial production is limited to specific geographical areas. Hence, other countries have to spend a lot of money to import it from producing countries (Dhen *et al*., 2018).

Because of an increase in the production cost of potted plants, and the possibility of introducing quarantine pests and diseases by importing cocopeat (Basirat, 2011), finding a cheap and available raw material to replace cocopeat has become a challenge for the plant growers. Iran has about 240000 ha cultivation area of palm date. Each palm date plant can produce about 37.5-75 kg of leaf waste, which is a massive amount by considering the whole palm date plants in Iran, but there is no proper management to use these wastes (Khademi *et al*., 2007). The date palm belongs to the coconut family, and its fiber has considerable similarity with coconut fruit fiber. This fiber is full of lignin making it difficult for microbial decomposition, so if used as growing media, it has good stability (Basirat, 2011; Dhen *et al*., 2018). Converting the pruning leaf and date cluster wastes into compost can provide an excellent growing media for the cultivation of ornamental plants.

Several reports are showing the potential of palm waste substrate for growing pot plants. This implies that the substrate can replace peat moss for other substrates such as coco peat and perlite (Hesami *et al*., 2010; Hematian Dehkordi *et al*., 2010). Palm wastes have a higher water holding capacity than coco peat and can absorb water 8.5 times its dry weight (Dhen *et al*., 2018; Chandrasekaran and Bahkali, 2013; Shirani, 2013). Wastes of date palm trees seem to be an innovative material in the horticulture industry, to be used as growing media (Mohammadi Ghehsareh, 2013) or as an organic fertilizer when used as biochar (Mahdi *et al*., 2013). The performance of palm-date wastes peat for plant growth may be leveraged in potted plant's production. Still, only

a few studies have used palm-date wastes as a substitute for peat and coco peat in potting substrates (Dhen *et al*., 2018). Palm celluloid wastes had a significant impact on the growth and total dry weight of *Aglaonema* sp. plants that were grown in mixing media compared to peat and peat-perlite potting media (Basirat, 2011). According to the results of Samiei *et al*. (2005) on *Aglaonema commutatum* cv. Silver Queen, the pure coco peat bed, made the highest growth level. There was no significant difference in leave surface index, root, and shoot dry weight between peat pure bed and palm cellulose waste. In growing *Dieffenbachia amoena*, palm waste compost was a suitable substrate for growth and could replace peat up to 70% in the peat-perlite composition (Noorani *et al*., 2013). Shabani *et al*. (2011) successfully used palm fibers as a complete or partial substitute for peat substrate in the bell peppers soilless cultivation. The results obtained by several studies revealed that palm waste-derived substrates were suitable for their use in peat substitution (Dhen *et al*., 2018; Ceglie *et al*., 2015; Rahbarian and Salehi Sardoei, 2014; Rostami *et al*., 2014; Mohammadi Ghehsareh, 2013; Flynn *et al*., 1995).

Due to the economic value of off-season production of lily flower and the need to find a suitable replacement for imported cocopeat, this study was conducted to evaluate the effects of cocopeat replacement by palm substrate on several physiological parameters, growth, aesthetic quality, and flower longevity in two lily cultivars.

MATERIALS AND METHODS

Plant materials and growth conditions

A factorial experiment was arranged in a completely randomized design with three replications and five plants in each replication. The first factor included two lilies cultivar Oriental hybrid *Lilium* 'Tiber' and Oriental × Trumpet hybrid *Lilium* 'Candy Club'. The second factor was the growing medium shown in table 1. The experiment was performed in a greenhouse with a day/night temperature of 20/15 ºC, relative humidity 50-70%, and light 20-30 kilolux (natural sunlight) from January to April 2018 at Dehaghan, Isfahan, Iran. Premature bulbs of 'Tiber' and 'Candy Club' cultivars by approximate 20-22 cm in circumference purchased from Vandenbos Company, Netherlands. Eight bulbs were cultivated into the plastic box (21 cm x 37 cm x 56 cm) in 12 cm depth, and each box was considered an experimental repeat (three boxes per treatment).

Two sources of palm substrate (palm trunk: Use only the trunk to prepare; palm tree: Use all parts of the tree to prepare) were used in this experiment. These were prepared by chopping the trunk and all parts of the palm tree into small sizes (1-4 mm). Several washes in fresh water and buffering treatment was performed in which calcium nitrate is added to leach out and remove any excess sodium and potassium from the material. The palm wastes were kept in 0.13 m^3 plastic bags to control the moisture and temperature. 0.5 g/l nitrogen fertilizer was added as a fermentation starter. Air holes were made on the bags to ensure respiration and the moisture was adjusted to 50%. During 3 months of incubation, these materials were mixed every week and put into the bags again. Also, some mixtures of growing media were evaluated for recovery and optimal use of reused cocopeat. Finally, eleven mixtures of growing media (Table 1) were assessed. Before planting, all prepared mixtures were washed and disinfected by steam. The physical and chemical characteristics of materials included in growing media are presented in tables 2 and 3.

Four weeks after the containers were placed in the greenhouse, plants were irrigated using three rows of drip tape placed up against each crate's length, three times a week. Fertilization conducted by the irrigation system at each watering, supplying; 180 mg/l KNO_3, 5.00 mg/l NH_4NO_3, 35.0 mg/l KH_2PO_4, 275 mg/l K_2SO_4, 160 mg/l $Ca(NO_3)_2$, 45.0 mg/l $MgSO_4$, 5.00 mg/l Fe-EDTA, 1.00 mg/l Mn-EDTA, 0.54 mg/l Zn-EDTA, 0.05 mg/l B_3BO_3, 0.66 mg/l $CuSO_4$, and 0.56 mg/l Na_2MoO_4. Nutrient solution pH and electrical conductivity (EC) were 5.5 and 2.8 dS/m, respectively.

Table 1. The compositions of used growing media.

	Compositions of growing media	Abbreviation
1	80% cocopeat + 20% perlite	C80+P20 (control)
2	60% cocopeat + 20% perlite + 20% palm trunk	C60+P20+PPa20
3	40% cocopeat + 20% perlite + 40% palm trunk	C40+P20+PPa40
4	20% cocopeat + 20% perlite + 60% palm trunk	C20+P20+PPa60
5	20% perlite + 80% palm trunk	P20+PPa80
6	60% cocopeat + 20% perlite + 20% palm tree	C60+P20+PPb20
7	40% cocopeat + 20% perlite + 40% palm tree	C40+P20+PPb40
8	20% cocopeat + 20% perlite + 60% palm tree	C20+P20+PPb60
9	20% perlite + 80% palm tree	P20+PPb80
10	20% fresh cocopeat+20% perlite+ 60% reused cocopeat	CN20+P20+CO60
11	20% perlite + 80% reused cocopeat	P20+CO80

Table 2. Physical properties of used substrates in growing media.

Substrate	Moisture %	Porosity %	Particle density g/cm^3	Bulk density g/cm^3	Water holding capacity %
Perlite	16.14	73.55	0.45	0.119	91
Cocopeat	13.96	73.08	0.52	0.140	812
Cocopeat+Perlite	15.02	73.79	0.58	0.150	572
Palm trunk	13.47	82.29	0.48	0.085	817
Palm tree	19.20	66.90	0.58	0.192	211

Table 3. Chemical properties of used substrates in growing media.

Substrate	pH	EC	CEC	N	P	K	Ca	Mn	Mg	Fe	Cu
	available										
		dS/m	cmol/kg	%					mg/kg		
Perlite	8.2	0.14	165	0.02	419	100	425	7.0	87.5	121	1.5
Cocopeat	7	0.44	227	3.60	420	405	1550	11.0	525	341	2.0
Cocopeat+perlite	7	0.52	209	3.44	578	178	2188	18.5	537	376	0.5
Palm trunk	7.5	0.93	196	3.81	566	38	2275	18.5	712	491	3.0
Palm tree	7	0.63	174	4.56	455	47	1775	11.0	500	325	3.0

CEC: Cation-exchange capacity.

Physicochemical properties of the substrates

The initial physical properties of the various substrates were determined following the procedures described by Gabriels *et al*. (1991, 1993). Samples from each of the substrates were wetted thoroughly in bulk batches. Samples of the media were placed into containers of known volumes and weight, with a fine mesh cloth that was attached to the base. After initial drainage, the substrate level in the container was adjusted. So, it was level with the top of the container, saturated with water for 48 h, then allowed to re-drain. The containers were weighed twice, before and after drying in an oven for 4 days at 60 ℃. The ash contents and organic matter contents of the substrate were determined in samples that had been incinerated at 550 ℃ for 5 h. From these measurements, the bulk density, particle density, total porosity, and water holding capacity were calculated using the below equations (Atiyeh *et al*., 2001; Raviv and Lieth, 2008).

$$\text{Bulk density (g/cm}^3\text{)} = \text{dry weight / volume} \quad (1)$$

$$\text{Particle density (g/cm}^3\text{)} = 1 / [\%\ \text{organic matter} / (100 \times 1.55) + \%\ \text{ash} / (100 \times 2.65)] \quad (2)$$

(1.55 and 2.65 are the average particle densities of soil organic and mineral matter, respectively.)

$$\text{Total porosity (\% volume)} = (1 - \text{Bulk density / Particle density}) \times 100 \quad (3)$$

$$\text{Water holding capacity (\% volume)} = [(\text{wet weight} - \text{dry weight}) / (\text{Specific gravity of water} \times \text{volume})] \times 100 \quad (4)$$

$$\text{Moisture (\%)} = [(\text{wet weight} - \text{dry weight}) / (\text{dry weight})] \times 100 \quad (5)$$

The pH (1:5 w/v substrate/double distilled water) was determined by a pH meter (Metrohm-262, Herisau, Switzerland) that has been agitated mechanically for 2 h and filtered through Whatman no. 1 filter paper. The same solution was measured for electrical conductivity with a flame photometer (Jenway models PFP 7 & PFP 7/C, Staffordshire, United Kingdom) that had been standardized with 0.01 and 0.1 M KCl (Gabriels *et al*., 1991). Cation-exchange capacity was assayed by barium acetate (Rippy and Nelson, 2007). Total N of growing media was measured by the Kjeldahl method as described by Singh and Pradhan (1981). The extraction of P, K, Ca, Mg, Fe, Cu, and Mn from the substrate samples was performed ammonium bicarbonate extraction after dry ashing at 550 ◦C for 5 h (Soltanpour, 1985). The concentration of P was assayed spectrophotometrically at 880 nm (UV-160A UV-Visible Recording Spectrophotometer, Shimadzu, Tokyo, Japan), K was measured flame photometrically, and Ca, Mg, Fe, Cu, and Mn contents were determined by atomic absorption (670 Shimadzu, Kyoto, Japan) (Page, 1983).

Vegetative and reproductive traits

The stem diameter, bud diameter, and bud length at harvesting time were defined as the maximum width of each stem and bud diameter and measured by vernier caliper with an accuracy of 0.01 mm. At harvesting time, all of the bulblets were counted and recorded as a bulblet's number.

To measure the flowering time, the number of days from planting the bulbs in the box to observing the first signs of flower bud emergence was counted (Mohammadi Torkashvand and Seyedi, 2016). The cut flowers from the same size were harvested, when the first signs of color appeared on the three flower buds (Hassanpour Asil, 2008) and considered as time to harvest the flower. After removing 3 cm of the basal part of the branch and also all leaves from 15 cm of the basal part of the branch (to be away from the water surface of the storage container), they were placed in distilled water.

Qualitative traits

The numbering scale also determined bud visual quality from 1 to 10 in which 1= lack of freshness and firmness and 10= freshness and firmness of flower and stem (Nazari *et al*., 2011). The quality index (g/cm) was determined as a fresh weight of the branch to the length of the branching ratio (Nazari *et al*., 2011).

The longevity of the flowers was measured as day from placing them on the preservation solution until the loss of the flower decorative (discoloration, wilting, and loss of their turgid) (Liao *et al*., 2012).

To determine the change of fresh weight, the new weight of the branch was measured before placing them on the preservation solution and recorded as W_0. The weight of branches was daily

measured as W_t till flowers were withered, and next, equation 6 was used for the determination of fresh weight change (Liao *et al*., 2012).

$$CFW = [(W_t - W_0) / W_0] \times 100 \quad (6)$$

Physiological traits

SPAD value is a non-destructive measurement of greenness from the last expanded leaf. The normalized SPAD index is expressed relative to SPAD reading a fully fertilized crop (Debaeke et al., 2006). The SPAD index of leaves was measured three times, one week before harvesting (SPAD1), in harvesting time (SPAD2), and one week after harvesting of flowers (SPAD3), by CL-01 Chlorophyll Meter (Hansatech Instrument Ltd, Kings Lynn, UK).

The relative water content of leaves (LRWC) and petals (PRWC) was measured using Agbaier (2009) methods using equations 7.

$$RWC\ (\%) = [(FW - DW) / (TW - DW)] \times 100 \quad (7)$$

FW= Fresh weight (mg), DW= Dry weight (mg), TW= Turgid weight (mg).

After a sampling of equal leaves and petals and washing them with distilled water, leaf's electrolyte leakage (LEL) and petal's electrolyte leakage (PEL) samples was measured by the method of Lutts *et al*. (1996) using equations 8.

$$Electrolyte\ leakage\ (\%) = (C0/C) \times 100 \quad (8)$$

Leaf chlorophyll content was determined after harvesting of cut flowers. Leaf materials (100 mg) were ground with a chilled pestle and mortar in diffuse light using 5 ml of 80% acetone and the homogenate was centrifuged at 3000 × *g* for 2 min. Aliquots of 5 ml of 80% acetone were added to the pellet and centrifuged until it was non-green. The supernatants were pooled and protected from light before the estimation of chlorophyll pigments. The absorbance of extracts was measured at 470 nm, 645 nm, and 663 nm with a spectrophotometer (Shimadzu, Kyoto, Japan) (AOAC, 2006).

Chlorophyll and carotenoids content were determined by Arnon's (1967) method using equations 9-13.

$$Chl.\ a\ (mg/l\ fresh\ weight) = (19.3\ A_{663} - 0.86\ A_{645})\ V\ /100W \quad (9)$$

$$Chl.\ b\ (mg/l\ fresh\ weight) = (19.3\ A_{645} - 3.6\ A_{663})\ V\ /\ 100W \quad (10)$$

$$Chl.\ t\ (mg/l\ fresh\ weight) = (0.0202\ A_{645} + 0.00802\ A_{663}) \quad (11)$$

$$Car.\ (mg/l\ fresh\ weight) = (100\ A_{470} - 3.27\ chl.\ a - 104\ chl.\ b)\ /\ 227 \quad (12)$$

$$(mg/g\ fresh\ weight) = (mg/l) \times 0.01\ (l)\ /\ weight\ (g) \quad (13)$$

Chl. a = Chlorophyll a; Chl. b = Chlorophyll b; Chl. t = Chlorophyll total; car = Carotenoides; A = Absorbance of specific wavelength; V = Final volume of chlorophyll extract in 80% Acetone (ml); W = Fresh weight of tissue extract (g)

Statical analysis

The statistical analysis was done using SAS (Statistical Analysis System, 2001), and Excel 2013 was also used to draw charts. Tukey's range test at 5% probability level was used for means comparison.

RESULTS AND DISCUSSION

Stem diameter

Stem diameter was affected by the effect of cultivar and media culture at the 1% probability level (Table 4). According to table 4, the 'Candy Club' cultivar made a thicker stem (8.99 mm) than the 'Tiber' cultivar (8.38 mm). Among the treatments, the thicker stem (9.37 mm) was observed in the control, which was not significantly different from the palm trunk substrate, CN20+P20+CO60, and P20+CO80 treatments (Table 4). The thinner stem (8.06 mm) was recorded in the C20+P20+PPb60 treatment, that significantly different from the control and P20+CO80 treatments (Table 4). The results of growth traits can be justified, essentially, by the substrates more favorable aeration that enhances the root oxygen demand and eventually permits more absorption of water and nutrients (Borji *et al*., 2010).

Sufficient properties with a view to low bulk density and high porosity in palm trunk substrate (Table 2) lead to better support of water and nutrient for plants and then better growth. Nazari *et al*. (2011) observed that the stem diameter of hyacinth was not affected by three used growing media. Another study showed that the stem diameter of lily is under the effects of growing media (Prisa *et al*., 2011). Riaz *et al*. (2015) observed that plants cultivated on higher potassium to phos-

Table 4. Mean comparison of simple effects of cultivar and treatment on stem diameter, flower diameter, bud length, time of flower emergence, bud visual quality, and quality index.

S.o.V		Stem diameter (mm)	Bud diameter (mm)	Bud length (mm)	Time of flower emergence (day)	Bud visual quality	Quality index (g/cm)
Cultivar	Tiber	8.38^{b}	32.83^{a}	105^{b}	53.72^{b}	7.62^{b}	1.61^{b}
	Candy Club	8.99^{a}	28.56^{b}	122^{a}	59.48^{a}	8.83^{a}	2.37^{a}
Treatment	C80+P20 (Control)	9.37^{a}	35.70^{a}	118^{ab}	55.16^{c}	8.22^{ab}	2.26^{a}
	C60+P20+PPa20	8.90^{a-c}	32.91^{ab}	123^{a}	55.16^{c}	8.36^{a}	2.20^{a}
	C40+P20+PPa40	8.58^{a-c}	32.33^{ab}	120^{ab}	55.50^{c}	8.48^{a}	2.03^{a-c}
	C20+P20+PPa60	8.60^{a-c}	30.45^{bc}	114^{ab}	56.16^{bc}	8.25^{ab}	2.08^{ab}
	P20+PPa80	9.36^{a}	30.35^{bc}	116^{ab}	55.83^{c}	8.13^{ab}	2.12^{ab}
	C60+P20+PPb20	8.40^{bc}	30.86^{bc}	114^{ab}	57.16^{a-c}	7.87^{a-c}	1.93^{b-d}
	C40+P20+PPb40	8.28^{bc}	29.93^{bc}	111^{b}	57.33^{a-c}	7.77^{a-c}	1.76^{c-e}
	C20+P20+PPb60	8.06^{c}	27.72^{cd}	102^{c}	58.50^{ab}	7.51^{bc}	1.63^{e}
	P20+PPb80	8.38^{cd}	25.96^{d}	97.72^{c}	59.66^{a}	7.28^{c}	1.67^{de}
	CN20+P20+CO60	8.57^{a-c}	30.97^{bc}	119^{ab}	55.83^{c}	8.50^{a}	2.04^{ab}
	P20+CO80	9.10^{ab}	30.46^{bc}	117^{ab}	56.33^{b-c}	8.29^{a}	2.18^{ab}
Cultivar (C)		**	**	**	**	**	**
Treatment (T)		**	**	*	**	**	**
C×T		ns	ns	ns	ns	ns	ns

Means with similar letter(s) in each column show the lack of a significant difference at the P<0.05 level based on the Tukey's range test. *, ** and ^{ns}: significant at P < 0.05, P < 0.01 and insignificant, respectively.

phorus ration produced thicker stems. According to these statements and also obtained results, it can be concluded that higher potassium to phosphorus ratio of substrates (Table 3) is not the only reason for the production of lily thicker stems. Because the palm tree substrate has a more K/P ratio than palm trunk substrate but, made thinner stem.

Bud diameter

Also, the bud diameter was affected by the effect of cultivar and media culture at the 1% probability level (Table 4). Table 4 also indicates that the 'Tiber' cultivar produced a thicker flower (32.83 mm). According to table 4, thicker flowers (35.70 mm) were observed in control, which was not significantly different from C60+P20+PPa20, C40+P20+PPa40, C60+P20+PPb20, and C40+P20+PPb40 treatments. The thinner flowers (25.96 cm) were made in P20+PPb80 treatment, which belongs to the same statistical group with C20+P20+PPb60 treatment (Table 4). Rose plants, which were cultivated in cocopeat produced denser flowers (Chavada, 2017). In gerbera, the plants that grow on the 70 % peat made thicker flowers than those cultivated on cocopeat-containing media. The 70 % of peat, had the least salinity (0.39 dS/m) compared to other media, hence good rooting medium provided helped in better nutrient absorption and growth for plants (Khalaj *et al*., 2011). Date-palm waste properties seem to be enhancer factors for their use as a growing medium, especially when blended with other substrates. This fact was following Mohammadi Ghehsareh *et al*. (2011) and Soltani and Naderi (2016) who found that the physicochemical properties of growing media affected plant growth. According to the mentioned observations and also the obtained results, it could be stated that the bud diameter was affected by the type of growing media as well as, palm trunk substrate can replace the 20-40% of cocopeat in growing media.

Bud length

The bud length was also under the effects of cultivar and media culture at 1% and 5% probability levels, respectively (Table 4). The longest buds (122 mm) were observed in the 'Candy Club' cultivar (Table 4). Among the treatments, the longest (123 mm) and shortest (97.72 mm) buds were observed in C60+P20+PPa20 and P20+PPb80 treatments, respectively (Table 4). There were significant differences among C60+P20+PPa20 treatment with C40+P20+PPb40, C20+P20+PPb60, and P20+PPb80 treatments. There was a significant difference between P20+PPb80, and C20+P20+PPb60 treatments (Table 4). In the rose plants, the bud length was affected by the type of growing media (Rezaee *et al*., 2013). It was observed, in lily plants, the length of buds was associated with growing conditions, as well as the number of buds (Treder, 2008). Treder (2008) indicated that the longer buds made in plants with a fewer number of buds. Also, he observed that an increase in nitrogen, potassium, and magnesium would lead to longer buds production. It was also stated that plants that received a complete nutrient solution had longer buds than those receiving only nitrogen (Treder, 2008). According to these reports and the results, despite the higher nitrogen content of palm trees than other substrates, 60%, and 80% of treatments lack the optimal concentration of different elements, producing shorter buds than palm trunk and control substrates. On the other hand, as the percentage of palm tree increases to 60% and 80% of media culture, the bulk density was increased, and the porosity was decreased, which may support the smaller bud length in the growth medium of 60% and 80% of the palm trees.

Time of flower emergence

The time of flower emergence was under the effects of cultivar and media culture at the 1% probability level (Table 4). The flowers of the 'Tiber' cultivar were emerged earlier (53.72 days) than the 'Candy Club' cultivar (59.48 days) (Table 4). Control and C60+P20+PPa20 treatment also emerged their flowers sooner (55.16 days) than other treatments, although there were

no significant differences among those treatments with C40+P20+PPa40, C20+P20+PPa60, P20+PPa80, C60+P20+PPb20, C40+P20+PPb40, CN20+P20+CO60, and P20+CO80 treatments (Table 4). The latest flower emergence (59.66 days) was observed in P20+PPb80 treatment, which belongs to the same statistical group with 20%, 40%, and 60% palm tree substrate treatment (Table 4). According to these results, it can be concluded that various cultivars differently respond to growing media, and it is not possible to recommend one type of growing media to different cultivars of lily plants. It was shown that the time of flower emergence of gerbera was not affected by growing media (Riaz *et al*., 2015). In the zinnia plant, the time of flower emergence affected by the type of growing media so that the silt treatment showed the earliest and the 1:1:1 composition of silt: peat: coconut fiber indicated the latest time of flower emergence (Riaz *et al*., 2008). Another study showed that the time of flower emergence in the *Matthiola incana* plant was also affected by growing media *(Waseem et al.*, 2013). The obtained results are consistent with Riaz *et al*.'s (2008) and Waseem *et al*.'s (2013) studies.

Bud visual quality and Quality index

The bud visual quality and quality index were affected by the effects of cultivar and media culture at the 1% probability level (Table 4). Table 4 shows that the 'Candy Club' cultivar was produced higher-quality flowers (8.83) than the 'Tiber' cultivar (7.62). The highest (8.50) bud visual quality was observed in CN20+P20+CO60 treatment, which belongs to the same statistical group with C40+P20+PPa40, C60+P20+PPa20, and P20+CO80 treatments (Table 4). On the other hand, the least bud visual quality was made in c20+ppb80 treatment, which belongs to the same statistical group with 20%, 40%, and 60 % palm tree substrates (Table 4). Nazari *et al*. (2011) observed that hyacinth plants cultivated on cocopeat contain media that had more bud visual quality than other treatments. They concluded that this observation might be due to its higher water holding capacity and the total porosity of cocopeat. Observation of the lack of influence of growing media on bud visual quality is not in line with Nazari *et al.* (2011) results.

The quality index was more in the 'Candy Club' cultivar (2.37 g/cm) than the 'Tiber' cultivar (1.61 g/cm) (Table 4). According to Table 4, the most (2.26 g/cm) and least (1.63 g/cm) quality index were calculated in control and C20+P20+PPb60 treatments. It was observed that there were no significant differences between control with all of the palm trunk substrates, CN20+P20+CO60, and P20+CO80 treatments as well as between C20+P20+PPb60 treatment with C40+P20+PPb40 and P20+PPb80 treatments (Table 4). The quality index of hyacinth was not affected by growing media (Nazari *et al*., 2011), but in pine plants, this index was significantly affected by growing media (Tsakaldimi, 2006). In ornamental cabbage, the plants treated with more than 10 mM nitrate showed a higher quality index and had more concentration of nitrogen, phosphorus, potassium, calcium, magnesium, and iron (Cardarelli *et al*., 2015). It could be concluded that nitrogen concentration is not the only factor affecting the quality index. The lower quality index plants were made in palm tree substrates with higher nitrogen content (Table 3). On the other hand, plants cultivated on growing media with a higher concentration of phosphorus, potassium, calcium, magnesium, and iron had higher quality index plants than those growing in palm tree substrates.

Number of bulblets

The number of bulblets was under the interaction effects of the cultivar and media culture at the 1% probability level (Table 5). In the 'Tiber' cultivar, the highest (12.6) and lowest (3.0) number of bulblets were observed in CN20+P20+CO60 and C20+P20+PPb60 treatments, respectively, which was not significantly different from each other (Table 5). In the 'Candy Club' cultivar, the highest number of bulblets (30.6) was recorded in P20+CO80 treatment, which belongs to the same statistical group with control, C40+P20+PPa40, and CN20+P20+CO60 treatments but, but

the lowest number of bulblets (3.3) was observed in P20+PPb80 which was significantly different from C40+P20+PPb40, CN20+P20+CO60, and P20+CO80 treatments (Table 5). Nazari *et al*. (2011) reported that the hyacinth bulblet's number was higher in the mixture containing an equal amount of sand: coco peat compared to other media.

Table 5. Mean comparison of the interaction effects of the cultivar in treatment on the number of bulblets, time to harvest of flower, flower longevity, SPAD2, and SPAD3.

Cultivar	Treatment	Number of bulblets	Time to harvest the flower (day)	Flower longevity (day)	SPAD2	SPAD3
	((Control C80+P20	9.3^{cd}	111^{f}	9.08^{f-h}	76.5^{ab}	82.5^{a}
	C60+P20+PPa20	6.0^{cd}	112^{d-f}	8.08^{hi}	74.0^{a-c}	74.3^{a-c}
	C40+P20+PPa40	4.3^{cd}	112^{d-f}	8.25^{hi}	67.7^{c-e}	73.5^{a-c}
	C20+P20+PPa60	5.0^{cd}	115^{a-e}	8.41^{hi}	69.8^{bc}	71.5^{a-d}
	P20+PPa80	10.6^{b-d}	116^{a-d}	9.25^{e-h}	71.1^{a-c}	68.4^{a-d}
Tiber	C60+P20+PPb20	5.6^{cd}	113^{c-f}	7.80^{hi}	68.9^{b-d}	71.6^{a-d}
	C40+P20+PPb40	3.3^{d}	112^{ef}	7.83^{hi}	61.03^{d-f}	66.2^{b-e}
	C20+P20+PPb60	3.0^{d}	113^{c-f}	7.46^{i}	59.9^{ef}	57.4^{d-g}
	P20+PPb80	6.3^{cd}	114^{c-f}	8.16^{hi}	57.6^{fg}	53.7^{e-g}
	CN20+P20+CO60	12.6^{a-d}	117^{a-c}	8.58^{g-i}	77.0^{ab}	72.8^{a-c}
	P20+CO80	8.3^{cd}	118^{ab}	9.25^{e-g}	78.5^{a}	75.3^{ab}
	(Control) C80+P20	15.6^{a-d}	115^{a-e}	9.86^{g-i}	75.8^{a-c}	78.8^{ab}
	C60+P20+PPa20	10.6^{b-d}	115^{a-e}	10.46^{c-f}	73.8^{a-c}	77.1^{ab}
	C40+P20+PPa40	21.3^{a-c}	116^{a-d}	10.6^{b-e}	72.3^{a-c}	74.9^{a-c}
	C20+P20+PPa60	11.6^{b-d}	113^{c-f}	10.46^{c-f}	71.9^{a-c}	71.7^{a-d}
	P20+PPa80	8.0^{cd}	116^{a-d}	11.33^{ab}	71.9^{a-c}	74.2^{a-c}
Candy Club	C60+P20+PPb20	7.6^{cd}	114^{c-f}	10.58^{c-f}	70.9^{a-c}	66.4^{b-e}
	C40+P20+PPb40	8.3^{cd}	113^{c-f}	11.63^{a-c}	59.4^{f}	60.4^{e-f}
	C20+P20+PPb60	7.6^{cd}	114^{c-f}	12.13^{a}	49.8^{gh}	46.8^{fg}
	P20+PPb80	3.3^{d}	114^{c-f}	12.06^{ab}	48.8^{h}	44.8^{g}
	CN20+P20+CO60	27.6^{ab}	114^{c-f}	10.06^{d-g}	78.6^{a}	77.8^{ab}
	P20+CO80	30.6^{a}	118^{a}	11.58^{a-c}	76.3^{ab}	73.7^{a-c}
Cultivar (C)		**	**	**	ns	ns
Treatment (T)		**	**	**	**	**
C×T		**	**	**	**	*

Means with similar letter(s) in each column show the lack of a significant difference at the $P < 0.05$ level based on the Tukey's range test. *, ** and ns: significant at $P<0.05$, $P<0.01$ and insignificant, respectively. SPAD2: In harvesting time, SPAD3: One week after harvesting of flowers.

Time to harvest of flower

According to Table 5, the harvest of the flower was affected by the interaction effects of the cultivar and media culture at the 1% probability level (Table 5). In both cultivars, the latest time to harvest (118 days for both cultivar) was recorded in P20+CO80 treatment (Table 5). In the 'Tiber' cultivar, P20+CO80 treatment was not significantly different from C20+P20+PPa60, P20+PPa80, and CN20+P20+CO60 treatments while, in the 'Candy Club' Cultivar, this treatment was not significantly different from control, C60+P20+PPa20, C40+P20+PPa40, and P20+PPa80 treatments (Table 5). According to table 5, the shortest time for harvesting the 'Tiber' cultivar (111 days) was observed in the control, which was not significantly different from

C60+P20+PPa20, C40+P20+PPa40, and all of the palm tree substrates treatments. In comparison, the shortest time to harvest of the 'Candy Club' cultivar (113 days) was recorded in C40+P20+PPb40 treatment, which was not significantly different from all other treatments except with P20+CO80 (Table 5). These results concur with the findings of Olympios (1992), and Kumar and Goh (1999) who discovered that the physiochemical properties of growing media affected plant growth and yield.

Flower longevity

The longevity of the flowers was another attribute affected by the interaction effects of the cultivar and media culture at the 1% probability level (Table 5). In table 5, in the 'Candy Club' cultivar, the highest longevity of the flowers (12.13 days) was observed in the C20+P20+PPb60 treatment, but in the 'Tiber' cultivar, this treatment indicated the lowest longevity of the flowers (7.46 days). The highest flower longevity of the 'Tiber' cultivar (9.25 days) was recorded in P20+PPa80 and P20+CO80 treatments, which were not statistically different from all other treatments except with C20+P20+PPb60 treatment (Table 5). The shortest flower longevity of the 'Candy Club' cultivar (10.06 days) was observed in CN20+P20+CO60 treatment, which belongs to the same statistical group with control, C60+P20+PPa20, and C20+P20+PPa60 treatments (Table 5). In the Candy Club cultivar, all of the treatments had higher flower longevity than the control. The longevity of flowers after harvest is controlled by several pre-and postharvest factors, whereas the pre-harvest longevity of flowers is influenced by the cultivar used, the supply of plant nutrients, and the growing medium (Khalaj, 2005). The type of growing medium used had no significant effect in increasing the longevity of the lily flowers (Hassanpour Asil, 2008). The longevity of the flowers is negatively affected by physiological and chemical processes (Al-Ajlouni *et al.*, 2017) like diminishing the water balance, destruction of photosynthesis pigments, and loss of cell membrane stability (Hajizadeh, 2016, Liao *et al.*, 2012). The results indicate that in both cultivars, the flower longevity was not related to RWC, photosynthesis pigments, and cell membrane stability. Al-Ajlouni *et al*. (2017) observed that plant that weekly received nutritional elements had more flower longevity than those that received nutritional elements daily, twice a week, or twice a month. They also revealed that lily plants cultivated on 50 mM nitrogen made more durable flowers than those grown on 100 mM nitrogen. In the 'Tiber' cultivar, plants grown on media with a lower amount of nitrogen made more durable flowers; however, this difference was not significant. In opposite to the 'Tiber', in the 'Candy Club' cultivar, treatments with a higher concentration of nitrogen have higher flower longevity. According to the mentioned above, the receiving of a balanced concentration of nutritional elements have more influence on the longevity of the flowers and various cultivar need to the different amount of elements which should be determined by test.

SPAD index

The SPAD1 was under the effects of cultivar and media culture at the 1% probability level (Table 6). The highest SPAD1 (73.38) was observed in the 'Tiber' cultivar (Table 6). Among the treatments, the highest (81.15) and lowest (52.9). The SPAD1 was measured in control and C20+P20+PPb60 treatments, respectively (Table 6). According to table 6, control, all of the palm trunk substrates, CN20+P20+CO60, and P20+CO80 treatments belong to the same statistical group, and also there were no significant differences between C20+P20+PPb60, C40+P20+PPb40, and P20+PPb80 treatments (Table 6).

Table 6. Mean comparison of simple effects of cultivar and treatment on SPAD1, LRWC, PRWC, LEL, and PEL.

S.o.V		SPAD1	LRWC %	PRWC %	LEL %	PEL %
Cultivar	Tiber	73.38^{a}	90.41^{b}	91.65^{a}	82.85^{b}	79.57^{a}
	Candy Club	66.45^{b}	91.22^{a}	90.40^{a}	84.28^{a}	82.05^{b}
Treatment	(Control) C80+P20	81.15^{a}	90.38^{ab}	91.27^{a}	82.04^{b}	79.54^{ab}
	C60+P20+PPa20	80.09^{ab}	92.22^{a}	92.63^{a}	82.46^{ab}	77.00^{b}
	C40+P20+PPa40	72.81^{a-c}	91.73^{ab}	88.17^{a}	84.56^{a}	82.16^{ab}
	C20+P20+PPa60	72.8^{a-c}	91.60^{ab}	90.37^{a}	84.57^{a}	80.88^{ab}
	P20+PPa80	71.85^{a-c}	91.59^{ab}	92.39^{a}	84.55^{a}	80.38^{ab}
	C60+P20+PPb20	66.98^{b-d}	90.38^{ab}	91.92^{a}	83.23^{ab}	78.50^{ab}
	C40+P20+PPb40	63.80^{c-e}	89.78^{ab}	91.97^{a}	84.19^{ab}	83.46^{ab}
	C20+P20+PPb60	52.90^{e}	91.08^{ab}	92.77^{a}	84.37^{ab}	83.56^{ab}
	P20+PPb80	55.03^{de}	91.16^{ab}	93.33^{a}	84.43^{ab}	85.87^{a}
	CN20+P20+CO60	78.86^{ab}	89.31^{b}	88.10^{a}	82.41^{ab}	78.06^{ab}
	P20+CO80	72.83^{a-c}	89.75^{ab}	88.37^{a}	82.39^{ab}	79.53^{ab}
Cultivar (C)		**	*	ns	**	*
Treatment (T)		**	*	ns	*	*
C×T		ns	ns	ns	ns	ns

Means with similar letter(s) in each column show the lack of a significant difference at the $P < 0.05$ level based on the Tukey's range test. *, ** and ns: significant at $P < 0.05$, $P < 0.01$ and insignificant, respectively. SPAD1: One week before harvesting, LRWC: Leaves relative water content, PRWC: Petal's relative water content, LEL: Leaves electrolyte leakage, PEL: Petal's electrolyte leakage.

The SPAD2 and SPAD3 were affected by the interaction effects of the cultivar and media culture at 1 and 5% probability levels, respectively (Table 5). The most SPAD2 of the 'Tiber' cultivar (78.5) was observed in P20+CO80 treatment, which belongs to the same statistical group with control, C60+P20+PPa20, P20+PPa80, and CN20+P20+CO60 treatments. On the other hand, the least SPAD2 of this cultivar (57.6) was observed in P20+PPb80 treatment, which was not significantly different from C40+P20+PPb40 and C20+P20+PPb60 treatments (Table 5). In the 'Candy Club' cultivar, the most (78.6) and least (48.8) SPAD2 was observed in CN20+P20+CO60 and P20+PPb80 treatments, respectively (Table 5). This table also indicates that there were not any significant differences between CN20+P20+CO60 treatment with control, all of the palm trunk substrates, C60+P20+PPb20, and P20+CO80 treatments as well as between P20+PPb80 treatment with C20+P20+PPb60 treatment.

In the 'Tiber' cultivar, the highest (82.5) and lowest (53.7) SPAD3 was observed in control and P20+PPb80 treatments, respectively (Table 5). In this cultivar, any differences between control with all of the palm trunk substrates, C60+P20+PPb20, cn20+p20+co80, and P20+CO80 treatments as well as between P20+PPb80 treatment with C40+P20+PPb40 and C20+P20+PPb60 treatments were not observed (Table 5). The highest (78.8) SPAD3 of the 'Candy Club' cultivar was observed in the control, which belongs to the same statistical group with all the palm trunk substrates, C60+P20+PPb20, CN20+P20+CO60, and P20+CO80 treatments (Table 5). The lowest amount of this index of the 'Candy Club' cultivar (44.8) was measured in P20+PPb80 treatment, which was significantly different from other treatments except with C20+P20+PPb60 treatment (Table 5).

According to these results, it can be concluded that palm trunk and reused cocopeat can be used as an alternative to a part or whole cocopeat in growing media of lily. The production of chlorophyll needs nitrogen, magnesium, sulfur, calcium, manganese, and zinc (Silva *et al*., 2010). Silva *et al*. (2010) concluded that higher chlorophyll content could result from a higher concentration of nutritional elements like nitrogen, phosphorus, potassium, and magnesium in growing

media. Observing such results can be derived from better availability of nutritional elements, especially nitrogen, phosphorus, magnesium, iron, zinc, and manganese in palm trunk than other substrates (Table 3) and, or easier absorption of these elements, especially iron and zinc, in those treatments.

Relative water content

Table 6 indicates that the LRWC was only affected by the effects of cultivar and media culture at the 5% probability level. Table 6 shows that the LRWC of the 'Candy Club' cultivar (91.22%) is higher than the 'Tiber' cultivar (90.41%). According to table 6, the most and least LRWC were observed in C60+P20+PPa20 and CN20+P20+CO60 treatments, respectively. Also, there were no significant differences among other treatments with C60+P20+PPa20 and CN20+P20+CO60 treatments (Table 6). The PRWC was not affected by experimental conditions (Table 6). Different substrates of growing media have unique physical characteristics. still appropriate aeration and water holding capacity are likely the most critical factors that play critical roles in plant growth and development (Singh *et al*., 2016). According to the results, it could be stated that none of the treatments were superior to control, in term of LRWC, but using the palm trunk in growing media led to more LRWC than other substrates, which can be resulted from the improvement of water to air ratio by using this substrate, and better moisturizing of plant by this type of palm peat.

Electrolyte leakage

The LEL was also affected only by the effects of cultivar and media culture at 1 and 5% probability level, respectively (Table 6). According to table 4, the most LEL (84.28%) was observed in the 'Candy Club' cultivar. Table 6 also indicates that C40+P20+PPa40 and C20+P20+PPa60 treatments show the most LEL (84.57%), which belonged to the same statistical group with other treatments except with control that showed the least LEL (82.04%).

The PEL was also affected by the effects of cultivar and media culture at the 5% probability level (Table 6). Same as the LEL, the most PEL (82.05%) was also observed in the 'Candy Club' cultivar (Table 6). The highest (85.87%) and the lowest (77.00%) PEL were observed in P20+PPb80 and C60+P20+PPa20 treatments, respectively (Table 6). There were not any significant differences between other treatments with P20+PPb80 and C60+P20+PPa20 treatments (Table 6).

The electrolyte leakage is among the most reliable indexes to measure the stress tolerance and stability of cell membranes. the least amount of electrolyte leakage means higher stress tolerance (Liao *et al*., 2012). There is a study that showed a delay in senescence of gladiolus cut flowers was associated with the higher stability of the cell membrane (Liao *et al.*, 2012). According to the results, it can be stated that the 'Tiber' cultivar and control (the lowest electrolyte leakage of leaves) and C60+P20+PPa20 (the lowest electrolyte leakage of petal) treatments can tolerate the severe stresses than other cultivar and media cultures then their flowers have more longevity. But unexpectedly, the most flower longevity was observed in the 'Candy Club' cultivar and the C20+P20+PPb60 treatment, which was significantly different from those treatments with the lowest electrolyte leakage of leaf and petal; such association was not observed in two studied lily cultivars.

Chlorophyll and carotenoids content

The content of chlorophyll a, b, and total were only under the effects of treatment at the 1% probability level (Table 7). Table 7 indicates that the most content of chlorophyll a (21.07 mg/g fresh weight) was measured in the control, which was not statistically different from the palm trunk substrates, C60+P20+PPb20, CN20+P20+CO60, and P20+CO80 treatments (Table 7). Also, C20+P20+PPb60 treatment was showed the least chlorophyll content (10.10 mg/g fresh weight),

which was not significantly different from 40% and 80% palm tree substrate (Table 7).

The most (5.66 mg/g fresh weight) and least (2.42 mg/g fresh weight) chlorophyll *b* content were observed in control and C20+P20+PPb60 treatments, respectively (Table 7). There were not any significant differences between control with C60+P20+PPa20, C20+P20+PPa60, P20+PPa80, CN20+P20+CO60, and P20+CO80 treatments as well as, between C20+P20+PPb60 treatment with C40+P20+PPb40 and P20+PPb80 treatment (Table 7).

Also, the highest total chlorophyll content (26.73 mg/g fresh weight) was observed in the control, while the lowest total chlorophyll content (12.52 mg/g fresh weight) was observed in the C20+P20+PPb60 treatment (Table 7). This Table also indicates that all of the palm trunk substrates, C60+P20+PPb20, CN20+P20+CO60, and P20+CO80 treatments belong to the same statistical group with control. There were not any significant differences between C20+P20+PPb60 treatment with C20+P20+PPb40 and P20+PPb80 treatment (Table 7).

Table 7. Mean comparison of the simple effects of treatment on chlorophyll a, chlorophyll b, total chlorophyll, and carotenoids content.

Treatment	Chlorophyll a (mg g^{-1} F.W.)	Chlorophyll b (mg g^{-1} F.W.)	Total chlorophyll (mg g^{-1} F.W.)	Carotenoids (µg g^{-1} F.W.)
(Control) C80+P20	21.07^{a}	5.66^{a}	26.73^{a}	37.09^{a}
C60+P20+PPa20	19.15^{a}	5.01^{ab}	24.16^{a}	37.64^{a}
C40+P20+PPa40	18.18^{ab}	4.31^{bc}	22.49^{ab}	36.54^{a}
C20+P20+PPa60	17.04^{ab}	4.97^{ab}	22.01^{ab}	35.70^{ab}
P20+PPa80	20.55^{a}	5.14^{ab}	25.69^{a}	37.17^{a}
C60+P20+PPb20	17.76^{ab}	4.27^{bc}	22.03^{ab}	32.92^{ab}
C40+P20+PPb40	14.13^{bc}	3.39^{cd}	17.52^{bc}	27.18^{bc}
C20+P20+PPb60	10.10^{c}	2.42^{d}	12.52^{c}	21.76^{d}
P20+PPb80	11.42^{c}	2.65^{d}	14.07^{c}	24.03^{c}
CN20+P20+CO60	20.70^{a}	5.22^{ab}	25.92^{a}	36.46^{a}
P20+CO80	19.54^{a}	4.78^{ab}	24.32^{a}	32.47^{ab}
Cultivar (C)	ns	ns	ns	ns
Treatment (T)	**	**	**	**
C×T	ns	ns	ns	ns

Means with similar letter(s) in each column show the lack of a significant difference at the P<0.05 level based on the Tukey's range test. *, ** and ns: significant at P<0.05, P<0.01 and insignificant, respectively.

Carotenoid content was affected only by the effects of treatment at the 1% probability level (Table 7). According to table 7, the most (37.64 mg/g fresh weight) and least (21.76 mg/g fresh weight) carotenoids content observed in C60+P20+PPa20 and C20+P20+PPb60 treatments, respectively (Table 7). There were no significant differences between C60+P20+PPa20 treatment with control, another palm trunk substrates, C60+P20+PPb20, CN20+P20+CO60, and P20+CO80 treatments (Table 7).

By considering all criteria, there were no significant differences between control with all palm trunk substrates (except for chlorophyll b content in C40+P20+PPa40), indicates the ability of these substrates as an alternative of cocopeat. The previous studies on hyacinth (Nazari *et al.*, 2011), gerbera (Manzari Tavakkoli *et al*., 2014), capsicum (Silva *et al*., 2010), and lettuce (Dhen *et al*., 2018) also indicated that the chlorophyll content is affected by growing media.

Changing of fresh weight

Fig. 1 A and B represent the changes in the fresh weight of cut flowers in the 'Tiber' and

the 'Candy Club' Cultivars, respectively. According to these figures, in both cultivars, all treatments positively changed the fresh weight until day two, but the changes were negative. Liao *et al*. (2012) concluded that the change of fresh weight might be related to the degree of stomata openness and water balance of plants. By detaching stems from maternal plants, they face stress, especially drought, and consequently, stomata will be closed. Next, by placing a branch on the preservative solution, water absorption will happen, and a change of fresh weight will be positive. Observation of negative change of fresh weight could be due to improper water absorption by stems that lack root system to compensate for the water shortage caused by transpiration and the respiratory process, and the consumption of stored assimilates in leaves and stems.

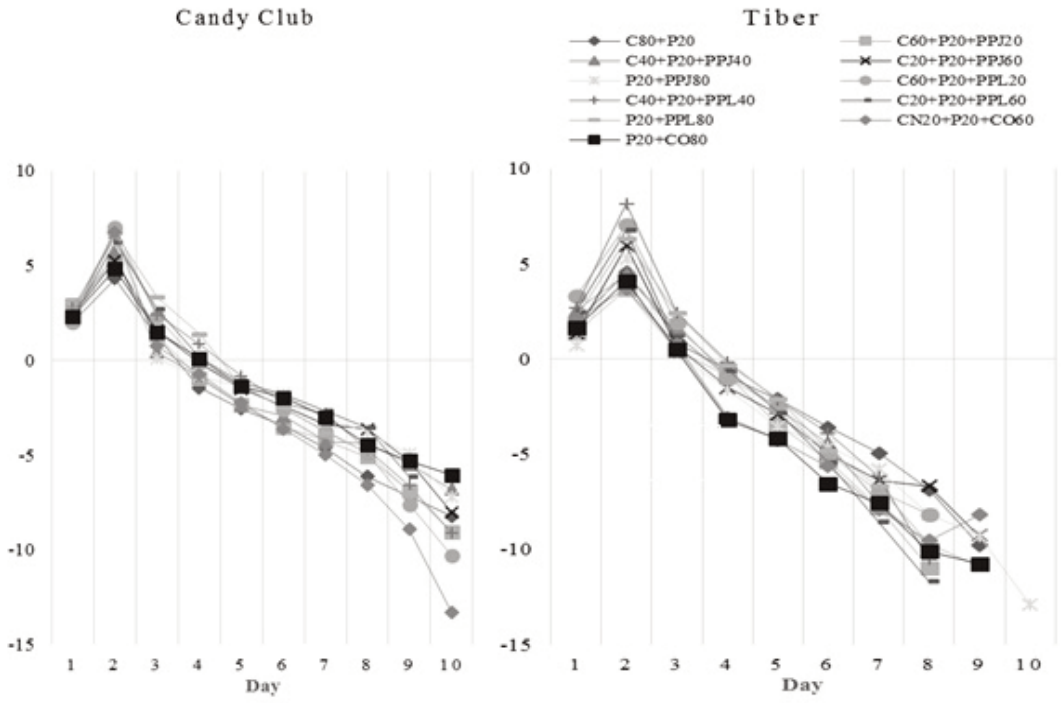

Fig. 1. Changes in fresh weight (%) of cut flower in 'Candy Club' and 'Tiber' cultivars.

CONCLUSION

The results indicated that various cultivars differently responded to the composition of growing media, and palm trunk substrates, as well as reused cocopeat, could replace a part and, or a whole part of expensive imported cocopeat. Overall, between these two sources of palm substrate and their effects on plant characters, the palm trunk substrates were superior to the palm tree substrates, but there was a low advantage of control media than the palm trunk substrates.

ACKNOWLEDGMENT

The authors are grateful to the research deputy University of Zanjan, Iran.

Literature Cited

Abad, M., Noguera, P., Puchades, R., Maquieira, A. and Noguera, V. 2002. Physico-chemical and chemical properties of some coconut coir dust for use as a peat substitute for containerized ornamental plants. Bioresource Technology, 82 (3): 241–245. http://doi.org/10.1016/S0960-8524(01)00189-4

Agbaire, P.O. 2009. Air pollution tolerance indices (APTI) of some plants around the erhoike-kokori oil exploration site of delta state, Nigeria. International Journal of Physical Sciences, 4 (6): 366–368.

Al-Ajlouni, M.G., Ayad, J.Y. and Othman, Y.A. 2017. Increasing nutrient levels promote growth and flower quality in lilies grown under soilless culture. Horticultural Science, 44 (4): 171–177. http://doi.org/10.17221/166/2016-HORTSCI

AOAC. 2006. Official methods of analysis. 18th ed. Assoc. of Official Analytical Chemists, Washington DC.

Arnon, A.N. 1967. Method of extraction of chlorophyll in the plants. Agronomy Journal, 23: 112–121.

Atiyeh, R.M., Edwards, C.A., Subler, S. and Metzger, J.D. 2001. Pig manure vermicompost as a component of a horticultural bedding plant medium: Effects on physicochemical properties and plant growth. Bioresource Technology, 78 (1): 11–20. http://doi.org/10.1016/s0960-8524(00)00172-3. PMID: 11265782

Awang, Y., Shaharom, A.S., Mohamad, R.B. and Selamat, A. 2009. Chemical and physical characteristics of cocopeat-based media mixtures and their effects on the growth and development of *Celosia cristata*. American Journal of Agricultural and Biological Sciences, 4 (1): 63–71. http://doi.org/10.3844/AJAB.2009.63.71

Awang, Y., Shazmi Shaharom, A., Mohamad, R.B. and Selamat, A. 2010. Growth dynamics of *Celosia cristata* grown in cocopeat, burnt rice hull, and kenaf core fiber mixtures. American Journal of Agricultural and Biological Sciences, 5 (1): 70–76. http://doi.org/10.3844/ajabssp.2010.70.76

Basirat, M. 2011. Use of palm waste cellulose as a substitute for common growing media in *Aglaonema* growing. Journal of Ornamental Plants, 1 (1): 1–11.

Borji, H., Mohammadi Ghehsareh, A. and Jafarpour, M. 2010. Effects of the substrate on lettuce in soilless culture. Research Journal of Agriculture and Biological Sciences, 6 (6): 923–927.

Burchi, G., Prisa, D., Ballarin, A. and Menesatti, P. 2010. Improvement of flower color by means of leaf treatments in lily. Scientia Horticulturae, 125 (3): 456–460. http://doi.org/10.1016/j.scienta.2010.04.028

Cardarelli, M., Rouphael, Y., Muntean, D. and Colla, G. 2015. Growth, quality index, and mineral composition of five ornamental cabbage cultivars grown under different nitrogen fertilization rates. HortScience, 50 (5): 688–693. http:// doi.org /10. 21273/hortsci.50.5.688

Ceglie, F.G., Bustamante, M.A., Ben Amara, M. and Tittarelli, F. 2015. The challenge of peat substitution in organic seedling production: Optimization of growing media formulation through mixture design and response surface analysis. PloS One, 10 (6): 1-14. doi:10.1371/journal.pone.01286 00

Chandrasekaran, M. and Bahkali, A.H. 2013. Valorization of date palm (*Phoenix dactylifera*) fruit processing by-products and wastes using bioprocess technology-review. Saudi Journal of Biological Sciences, 20: 105–120. doi: 10.1016/ j.sjbs.2012.12.004

Chavada, J.R. 2017. Effect of potting media on growth, flower yield, and quality of rose (*Rosa hybrida* L.) cv. Top Secret under protected condition. International Journal of Pure and Applied Bioscience, 5 (5): 821–827. http://doi.org/10.18782/2320-7051.5377

Datta, S.K., Chakrabarty, D., Gupta, V.N. and Verma, A.K. 2013. Changes in antioxidant activities in chrysanthemum cut spray during storage and packaging. Science and Culture, 79: 83–186.

Debaeke, P., Rouet, P. and Justes, E. 2006. Relationship between the normalized SPAD index and the nitrogen nutrition index: Application to Durum wheat. Journal of Plant Nutrition, 29: 75–92. https://doi.org/10.1080/01904160500416471

Dhen, N., Abed, S.B., Zouba, A., Haouala, F. and Al-Mohandes Dridi, B. 2018. The challenge of

using date branch waste as a peat substitute in container nursery production of lettuce (*Lactuca sativa* L.). International Journal of recycling Organic Waste in Agriculture, 7 (4): 357–364. http://doi.org/10.1007/s40093-018-0221-y

Doaguie, A. and Ghazanfari Moghadam, A. 2015. The application of date palm fibers as growth medium and optimization of moisture content and holding capacity by response surface methodology. Journal of Science and Technology of Greenhouse Culture, 5 (20): 1–14.

Flynn, R.P., Wood, C.W. and Guertal, E.A. 1995. Lettuce response to composted broiler litter as a potting substrate component. Journal of the American Society for Horticultural Science, 120 (6): 964–970.

Gabriels, R., van Keirsbulck, W. and Engels, H. 1993. A rapid method for the determination of the physical properties of growing media. Acta Horticulturae, 342: 243–248. doi:10.17660/actahortic.1993.342.27

Gabriels, R., van Keirsbulck, W. and Verdonck, O. 1991. Reference method for physical and chemical characterization of growing media: An international comparative study. Acta Horticulturae, 294: 147–160.

Hajizadeh, H.S. 2016. The effect of 5-sulfosalicylic acid application during pre-and postharvest on quality of lilium (*Lilium longiflorum*) cut flowers. Acta Horticulturae, 1131: 49–56. http://doi.org/10.17660/ActaHortic.2016.1131.7

Hassanpour Asil, M. 2008. Effects of growing medium on some postharvest characteristics of cut flowers in six cultivars of Asiatic hybrid lilies (*Lilium longiflorum* L.). Journal of Food, Agriculture and Environment, 6 (2): 442–446.

Hematian Dehkordi, M., Mohamadi Ghehsareh, A. and Kalbasi, M. 2010. Effect of palm peat and its mixtures with soil on yield and some growth index of hydroponically grown cucumber. Proceedings of the 5th National Conference on New Ideas in Agricultural Branch, Isfahan, Iran. P: 215.

Hesami, A., Amini, F., Sarikhani, Q. and Birghdarkashkol, A. 2010. Use of palm waste as an alternative to the cocopeat hydroponic strawberry cultivation. Proceedings of the Second National Conference on Agriculture and Sustainable Development. 1-4.

Kafi, M. and Ghahsareh, M. 2009. Floriculture. 4th edition, Jahad Press, Tehran, Volume 1, pages 108–118.

Khademi, R., Behseresht, R. and Faraz, N. 2007. Appropriate strategies for managing crop residue in palm groves of Country. Zeytoon, 178: 12–18.

Khalaj, M.A. 2005. Effect of cultivation intervals on growth and function of lilies. Fourth Iranian Horticultural Science Congress, 345.

Khalaj, M.A., Amiri, M. and Sindhu, S.S. 2011. The Response of different growing media on the growth and yield of gerbera in an open hydroponic system. Indian Journal of Horticulture,1 (3): 185–189.

Kumar, K. and Goh, K.M. 1999. Crop residues and management practices: Effects on soil quality, soil nitrogen dynamics, crop yield, and nitrogen recovery. Advances in Agronomy, 68: 197–319. http://dx.doi.org/10.1016/S0065-2113(08)60846-9

Le Nard, M. and de Hertogh, A.A. 1993. *Tulipa*. In the physiology of flower bulbs, A. de Hertogh, and M. le Nard, eds. (Elsevier), p.617–682

Liao, W., Zhang, M., Huang, G. and Yu, J. 2012. Hydrogen peroxide in the vase solution increases vase life and keeping the quality of cut Oriental × Trumpet hybrid lily 'Manissa'. Scientia Horticulturae, 139: 32–38. http:// doi.org /10.1016 /j. scienta. 2012.02.040

Lutts, S., Kinet, J.M. and Bouharmont, J. 1996. NaCl-induced senescence in leaves of rice (*Oryza sativa* L.) cultivars differing in salinity resistance. Annals of Botany, 78: 389-398.

Mahdi, Z., El Hanandeh, A. and Yu, Q.J. 2015. Date palm (*Phoenix dactylifera* L.) seed character-

ization for biochar preparation. *In*: The 6th International Conference on Engineering, Project, and Production Management (EPPM), 2–4 September 2015, Gold Coast.

Malik, K.M. 2014. Studies on flower regulation in Asiatic lilium (*Lilium x elegans Thunb*). University of Agricultural Sciences and Technology of Kashmir.

Manzari Tavakkoli, M., Roosta, H.R. and Hamidpour, M. 2014. Identification of suitable growth media for alleviating the adverse effect of sodium bicarbonate on gerbera in the soilless culture system. Journal of Science and Technology of Greenhouse Culture, 5 (17): 39–52.

Merhaut, D. and Newman, J. 2005. Effects of substrate type on plant growth and nitrate leaching in cut flower production of oriental lily. HortScience, 40 (7): 2135–2137. http://doi.org/10.21273/hortsci.40.7.2135

Mohammadi Ghehsareh, A. 2013. Effect of date palm wastes and rice hull mixed with soil on growth and yield of cucumber in greenhouse culture. International Journal of Recycling Organic Waste in Agriculture, 2–17. doi:10.1186/2251-7715-2-17

Mohammadi Ghehsareh, A., Borji, H. and Jafarpour, M. 2011. Effect of some culture substrates (date-palm peat, cocopeat, and perlite) on some growing indices and nutrient elements uptake in the greenhouse. African Journal of Microbiology Research, 5 (12): 1437–1442. doi:10.5897/AJMR1 0.786

Mohammadi Torkashvand, A. and Seyedi, N. 2016. To evaluate Ca concentration in nutrient solution and growth medium on the quantitative and qualitative yield of lilium (Asiatic hybrid *Lilium*). Iranian Journal of Horticultural Science, 46 (4): 637–647.

Nazari, F., Farahmand, H., Khosh-Khui, M. and Salehi, H. 2011. Effects of coir as a component of potting media on growth, flowering, and physiological characteristics of hyacinth (*Hyacinthus orientalis* L. cv. Sonbol-e-Irani). International Journal of Agriculture and Food Science, 1 (2): 34–38.

Noorani, S.H., Kafi, M. and Mahboob Khomami, A. 2013. The effect of palm waste compost as a peat substitute on the cultivation of the *Diephenbachia* ornamental plant. Journal of Science and Technology of Greenhouse Culture, 4 (15): 89–98.

Olympios, C.M. 1992. Soilless media under protected cultivation. Rockwool, peat, perlite, and other substrates. Acta Horticulturae, 323: 215–235.

Page, A.L. 1983. Methods of soil analysis: Part 2 chemical and microbiological properties, 9.2.2, Second Edition. American Society of Agronomy, Inc., Soil Science Society of America, Inc. 698 pages.

Prisa, D., Burchi, G., Antonetti, M. and Teani, A. 2011. Use of organic or inorganic substrates for reducing the use of peat and improving the quality of bulbs and inflorescences in Asiatic lily. Acta Horticulturae, 900: 143–148. http:// doi.org /10.17660/ActaHortic.2011.900.17

Rahbarian, P. and Salehi Sardoei, A.S. 2014. Effect of different media on growth, sucker, and chlorophyll of *Pandanus* spp. in under system mist. International Journal of Farming and Allied Sciences, 3 (3): 285–288.

Raviv, M. and Lieth, J.H. 2008. Soilless culture: Theory and practice. London: Elsevier. pp. 245-269.

Rezaee, A., Mobli, M., Etemadi, N., Baninasab, B. and Khoshgoftarmanesh, A.H. 2013. Effect of different growing substrates on the yield and cut flower quality of rose cv. Maroussia. Journal of Science and Technology of Greenhouse Culture, 4 (1): 105–114.

Riaz, A., Arshad, M., Younis, A., Raza, A. and Hameed, M. 2008. Effects of different growing media on growth and flowering of *Zinnia elegans* cv. Blue Point. Pakistan Journal of Botany, 40 (4): 1579–1585.

Riaz, A., Younis, A., Ghani, I., Tariq, U. and Ahsan, M. 2015. Agricultural waste as a growing media component for the growth and flowering of *Gerbera jamesonii* cv. Hybrid Mix. In-

ternational Journal of Recycling Organic Waste in Agriculture, 4 (3): 197–204. http://doi.org/10.1007/s40093-015-0099-x

Rippy, J.F.M. and Nelson, P.V. 2007. Cation exchange capacity and base saturation variation among Alberta, Canada, moss peats. HortScience, 42 (2): 349–352. doi:10.21273/hortsci.42.2.349

Rostami, Z., Mohammadi Ghehsareh, A. and Kavoos, B. 2014. Date palm waste application as culture media for strawberry and its impact on some growth indices and yield components. Agriculture Community, 2 (3): 15–21. https:// www. cabdirect.org/cabdirect/abstr act/20143 28704 6

Samiei, L., Khalighi, A., Kafi, M., Samavat, S. and Arghavani, M. 2005. An investigation of substitution of peat moss with palm tree celluloid wastes in growing aglaonema (*Aglaonema commutatum* cv. Silver Queen). Iranian Journal of Agriculture Science, 36 (2): 503-510.

Shabani, T., Peyvast, Gh. and Olfati, J. 2011. Evaluation of growing media on quantitative and qualitative traits of three cultivars of bell pepper in the soilless cultivation system. Journal of Science and Technology of Greenhouse Culture, 2 (6): 11–20.

Shirani, M. 2013. Use of date-palm wastes as a substrate on tomato yield and number. Biological Journal of Armenia, 1 (65): 63–67.

Silva, J.D.C., Leal, T.T.B., Araújo, A.S.F., Araujo, R.M., Gomes, R.L.F., Melo, W.J. and Singh, R.P. 2010. Effect of different tannery sludge compost amendment rates on growth, biomass accumulation, and yield responses of *Capsicum* plants. Waste Management, 30 (10): 1976–1980. http://doi.org/10.1016/j.wasman.2010.03.011

Singh, S., Dubey, R.K. and Kukal, S.S. 2016. Nitrogen supplemented cocopeat-based organic wastes as potting media mixtures for the growth and flowering of *Chrysanthemum*. Communications in Soil Science and Plant Analysis, 47 (16): 1856–1865. http://doi.org/10.1080/00103624.2016.1206119

Singh, R. and Pradhan, K. 1981. Determination of nitrogen and protein by Kjeldahl method. *In*: Forage Evaluation Science. New Delhi: Pvt. Publishers Ltd.

Soltani, M. and Naderi, D. 2016. Yield compounds and nutrient elements of carnation (*Dianthus caryophyllus* L.) under different growing media. Open Journal of Ecology, 6: 184–191. http://doi.org/10.4236/oje.2016.64019

Soltanpour, P. 1985. Use of ammonium bicarbonate DTPA soil test to evaluate elemental availability and toxicity. Communications in Soil Science and Plant Analysis, 16 (3): 323–338.

Treder, J. 2008. The effects of cocopeat and fertilization on the growth and flowering of Oriental lily 'Star Gazer'. Journal of Fruit and Ornamental Plant Research, 16: 361–370.

Tsakaldimi, M. 2006. Kenaf (*Hibiscus cannabinus* L.) core and rice hulls as components of container media for growing *Pinus halepensis* M. seedlings. Bioresource Technology, 97 (14): 1631–1639. http://doi.org/10.1016/j.biortech.2005.07.027

Wani, M.A., Nazki, I., Din, A., Malik, S. and Rather, Z. 2016. Photosynthate partitioning in Asiatic lilies under ammoniacal and nitrate sources of nitrogen. Agricultural Sciences, 5: 230–235.

Waseem, K., Hameed, A., Jilani, M.S., Kiran, M., Mamoon-Ur-Rasheed, Ghazanfarullah Javeria, S. and Ali Jilani, T. 2013. Effect of different growing media on the growth and flowering of stock (*Matthiola incana*) under the agro-climatic condition of Dera Ismail Khan. Pakistan Journal of Agricultural Sciences, 50 (3): 523–527.

How to cite this article:

Heidari, S., Mortazavi, S.N., Reezi, S. and Nikbakht, A. 2022. The possibility of replacing the cocopeat by palm substrate to the soilless culture of Lily. *Journal of Ornamental Plants,* 12(1), 11-29.

URL: http://jornamental.iaurasht.ac.ir/article_690033_5891899e860753c390f4f31bb6cc9112.pdf