Journal of Plant Physiology and Breeding

2021, 11(1): 123-135 ISSN: 2008-5168

Effects of potting media on flowering time and important marketing traits of Lily (*Lilium* spp.) cut flower in soilless culture

Saadollah Alizadeh Ajirlo[1*], Ramin Nickrazm[2], Ahmad Khaligy[3], and Seyed Jalal Tabatabaei[4]

Received: April 22, 2021 Accepted: June 28, 2021
[1]Department of Landscape Architecture, University of Tabriz, Tabriz, Iran
[2]Former MSc Student, Islamic Azad University, Science and Research Branch, Tehran, Iran
[3]Islamic Azad University, Science and Research Branch, Tehran, Iran
[4]Department of Horticultural Sciences, Shahed University, Tehran, Iran
*****Corresponding author; Email**:** azajirlo@tabrizu.ac.ir

Abstract
Effects of several soilless growing media on the flowering time, flower bud number, flower number, flower size, and stem height of Lilium cut flower was studied. The treatments were arranged as factorial based on a completely randomized design with 10 growing media and two cultivars of Bernini (Oriental) and Ceb Dazzle (Asiatic) using four replications. The growing media were different organic and mineral components as sand, vermiculite, perlite, cocopeat, and their combinations at equal volumes (50:50). Daily fertigation of the pots with 250 ml of the Hougland solution was carried out, which started one week after sowing the bulbs. Growth and development of plants were monitored and the data was recorded accordingly. The results indicated that cocopeat as a culture medium was superior to others in terms of accelerating flowering time, flower bud number per plant, flower number per plant, flower size, and stem height in both cultivars. The earliest flowering was observed on Bernini and Ceb Dazzle CVs. cultivated in sand and vermiculite media, respectively. The media containing cocopeat (50 and 100 percent) yielded the higher flower bud and flower number, flower size, and stem height in comparison to other mixtures.

Keywords: Flower traits; Flowering time; Growing medium; Lilium; Soilless culture

Citation: Alizadeh Ajirlo S, Nickrazm R, Khaligy A, and Tabatabaei SJ, 2021. Effects of potting media on flowering time and important marketing traits of Lily (*Lilium* spp.) cut flower in soilless culture. Journal of Plant Physiology and Breeding 11(1): 123-135.

Introduction

Lilium is one of the important floricultural crops in the world and occupies the 4th position within the bulbous plants after *Tulipa*, *Gladiolus*, and *Narcissus* (De Hertogh 1996). Asiatic and Oriental hybrids of lily are highly demanded by international markets and because of its numerous species and wide range of variation among the cultivars, demand for this crop has been increased in the recent three decades. It is cultivated on the different beds containing soil, organic, and mineral substrates and management of its nutrition has great importance in terms of growth, development, quality of flower, flower bud number, and other commercial traits of the delivered products.

Soilless culture is one of the proper techniques to increase water use efficiency, overcome local water scarcity, and facilitate the growth of high-quality products even in areas with poor soil and unfavorable conditions (Gruda 2019). This growing system is less harmful to the environment and provides optimal conditions for plant growth and higher yield in comparison to conventional farming. This approach, can improve productivity regardless of the climate conditions

and also optimize the management of inputs (fertilizers, pesticides), in a given economic and environmental circumstances (Montagne *et al.* 2016).

An effective soilless growing medium is the fundamental component of the soilless culture and nowadays various mineral and organic substrates are used as the bed on these culture systems. Coir, pine bark, wood fiber, and green composts have become the most commonly used alternative materials to peat (Barrett *et al.* 2016). An appropriate growing bed should have suitable physical, chemical, and biological characteristics and must be durable, available sufficiently, and relatively inexpensive, and for ease of application and economically efficient shipment, it should be light enough (Davidson *et al.* 1998). It has been reported that different crops and even their cultivars have various responses to growing media. Worrall (1981) studied the growth and development of foliage and flowering ornamentals in the growing media with different percentages of cocopeat and found that the most suitable media were ranged from no peat (for *Peperomia*) to 20-50 percent peat (for *Pilea, Schefflera, Diffenbachia, Coleus, Adiantum,* and *Saintpaulia*). Menzies and Aitken (1996) investigated the three different crops (tomato, petunia, Boston fern) concerning the efficiency of soilless growing media and concluded that fly ash was more efficient for tomato and petunia but was not suitable for growing Boston fern. However, root damage by fungal infection in the Boston fern was observed by them and they attributed the problem to waterlog in this medium. Magnani *et al.* (2003) studied the efficiency of lapillus as a growing medium for the cultivars of *Gladiolus* and *Lilium* and observed significant differences among the cultivars for their performance. Wilson *et al.* (2009) reported that the *Aglaonema* cultured in the growing media combined of different ratios of peat–bark–stalite–rice hulls–coir showed no significant change in plant height, growth index, visual quality, and shoot and root dry weight at week 24. They suggested that *Aglaonema* tolerates a broad range of chemical, physical, and nutritional characteristics of the growing media.

In the ornamental plants' industry, markets demand high-quality products, and even in the cases such as the cut flower of rose, the products with stems of less than 30 cm are not marketable. The attitude of the customers to the lily cut flower is similar to the rose cut flower and therefore the growers of lily must deliver the high-quality product to the market. To grow and produce high-quality lily cut flower in the soilless culture it is highly important to determine the most efficient medium for this purpose. Our goal in this study was to investigate the effects of different organic and mineral media such as sand, perlite, vermiculite, cocopeat, and their mixtures on the growth, development, and especially, commercial traits of the two lily cultivars in the soilless culture.

Materials and Methods

The investigation was conducted at the greenhouse of the Faculty of Agriculture, University of Tabriz, Tabriz (38^{o} 30' N, 46^{o} 17' E, 1567 m from the sea level), Iran. The bulbs of two

lily cultivars (Bernini, Ceb Dazzle) were purchased from the Onings Co. (www.onings.com), which is known internationally for the production of these crops. The bulbs were stored at the 4° C in the refrigerator and then transplanted to the pots on August 27. They were sown at the depth of 12 cm in the pots filled with the determined media according to the experimental treatments. The pots were of the common type with the plastic base, black colored, with the top diameter of 23 cm, and disinfected before sowing the bulbs using 2% sodium hypochlorite. The greenhouse temperature was adjusted at 25±3° C and 18±3 ° C for day and night, respectively. The humidity of the greenhouse was kept at a range of 50% to 70% by spaying the water on the floor of the greenhouse. The supplemental light for cloudy or short days of the fall season was provided using the high-pressure sodium lamp installed at the 80 cm height above the plants. The experiment was conducted as factorial based on a completely randomized design with two cultivars and 10 growing media with four replications. The media were organic or mineral substrates including sand, vermiculite, perlite, cocopeat, and their combinations with equal volumes. The size of the used sand particles was at the range between 2 and 5 mm, which were washed and pasteurized at 60° C. The cocopeat was prepared using the compacted commercial bails by wetting it thoroughly to get a loose and homogenized substrate. Perlite and vermiculite were applied directly to the culture media. Characteristics of the used growing media in this study were presented in Table 1. The Hoagland solution was used for the fertigation of the plants. The pH and EC (electric conductivity) of the solution were measured and controlled by the pH meter (HANA Instruments Inc., USA), and the EC meter (HANA Instruments Inc., USA; EC 215), respectively. The pH and EC of the solution were adjusted to around 6.5 and 1.5 m/ds, respectively by adding nitric acid or KOH accordingly. These parameters were constantly monitored through the growing period of the plants. To minimize the pH and EC fluctuations of the solutions, they were not kept for more than 7 days and periodically replaced with the freshly prepared solutions.

Fertigation was conducted using the open system and 250 cm^3/day of the solution was supplied for each pot. To leach out the accumulated salts from the beds, the growing media were washed with pure water every 10 days. The exact flowering dates were determined based on the observations of flower development in each plant and the number of days to flowering was recorded accordingly. The number of flower buds and fully developed flowers at anthesis were also recorded. The diameter of the fully opened flowers was measured using a tape meter. The plant height was recorded at the end of the vegetative phase by measuring the length between the crown and top of the main stem. Analysis of variance (ANOVA) and comparison of the means (Duncan's Multiple Range Test) was carried out by the SPSS software. The graphs were prepared using Excel software.

Table 1. Characteristics of used growing media in the study

Substrate	pH	CEC (meq/100 g)	Bulk density (g/cm3)	Water retention capacity (%)
Sand	6.2	0.0	1.68	182
Vermiculite	6.7	173	0.49	584
Cocopeat	5.4	120	0.15	712
Perlite	6.3	0.0	0.32	374

Results and Discussion

Effect of culture medium and cultivar on different characteristics of the lily

Flowering time

The flowering of treated lily plants occurred between the dates of December 6 to December 19 and the days to flowering varied between 101 to 125.5 days. ANOVA indicated that the main effects of cultivar, culture media, and their interaction had a significant ($p \leq 0.01$) effect on the flowering time of lily (Table 2). The Ceb Dazzle cultivar entered the flowering period 24.5 days earlier than the Bernini cultivar. Growing media of vermiculite followed by sand had promotive effects on the earliness of flowering whereas in the cases cultured at the cocopeat medium the flowering was delayed (Table 3). The longest and shortest flowering time was recorded for the Bernini cultivar cultured at the cocopeat medium and the Ceb Dazzle cultivar sown at the vermiculite medium, respectively (Figure 1).

The flowering time of a cut flower is essential for the management of the cultivation time and supplying the product to the market on a suitable date. It depends both on the genetics of the plant and environmental conditions. Preciseschedulingof the ornamental plants' production reduces cultural costs and balances between demand and supply, which was described as art and science (Larson 1992). Hahn *et al.* (2001) observed the difference in days to flowering of the gerbera cultivated in rockwool and soil growing media which were 50 and 60 days, respectively. Chang *et al.* (2012) observed that humic acid and calcium accelerated the flowering of lily and the flowers were induced and developed 8 days earlier on the treated plants as compared to the control plants.

Number of flower buds

Flower buds emerged gradually either individually at the end of branches (the Bernini cultivar) or in the groups on the upper end of the main stem (the Ceb Dazzle cultivar) of the lily plants almost 90 days after planting. The number of flower buds of the lily plants was affected significantly by the cultivar, growing media, and their interaction (Table 2). The Ceb Dazzle cultivar had a higher flower bud number than Bernini (Figure 2) in all growing media. The medium consisted of cocopeat alone was the most promotive for the flower bud number whereas this trait decreased considerably in the sand, vermiculite, and their combination. The highest

Table 2. Analysis of variance for the effects of treatments on growth and quality of two lily cultivars

Sources of variation	Degree of freedom	Mean squares				
		Flowering time	Flower-bud number	Flower number	Flower size	Plant height
Media	9	148.28**	8.06**	8.98**	28.32**	1303.92**
Cultivar	1	2995.13**	530.45**	33.80**	99.68**	1309.71**
Media × Cultivar	9	5.84**	2.48**	1.50*	4.60**	100.83**
Error	60	0.41	0.49	0.49	0.155	0.28

* and **significant at 5% and 1% probability levels, respectively.

Table 3. Comparison of different media for flowering time and marketing features of the lily

Medium	Flower-bud No.	Flower No.	Plant height (cm)	Days to flowering	Flower size (cm)	Stem length (cm)
Perlite	5.75^{e}	3.75^{cd}	72.65^{g}	117.00^{g}	16.60^{c}	72.65^{de}
Vermiculite	5.75^{e}	3.50^{d}	74.00^{f}	107.60^{a}	15.25^{e}	74.00^{cd}
Cocopeat	8.88^{a}	6.75^{a}	109.71^{a}	119.00^{g}	21.54^{a}	109.71^{a}
Sand	6.75^{d}	4.25^{bcd}	67.81^{i}	109.00^{b}	16.79^{c}	67.81^{e}
Perlite + Vermiculite	7.00^{cd}	4.25^{bcd}	74.69^{e}	117.00^{f}	16.69^{c}	74.68^{cd}
Perlite + Ccocopeat	8.00^{b}	4.88^{b}	85.46^{c}	118.90^{g}	16.50^{c}	85.46^{b}
Perlite + Sand	6.25^{de}	3.88^{cd}	67.64^{i}	116.50^{f}	16.39^{c}	67.64^{e}
Vermiculite + Cocopeat	6.63^{d}	4.75^{b}	87.57^{b}	110.75^{d}	18.79^{b}	87.57^{b}
Vermiculite + Sand	6.25^{de}	2.75^{e}	70.61^{h}	109.75^{c}	15.81^{d}	70.61^{de}
Cocopeat + Sand	7.50^{bc}	4.50^{bc}	78.84^{d}	113.50^{e}	18.94^{b}	78.84^{c}

Means with similar letters are not significantly different at p≤ 0.01 (Duncan's Multiple Range Test).

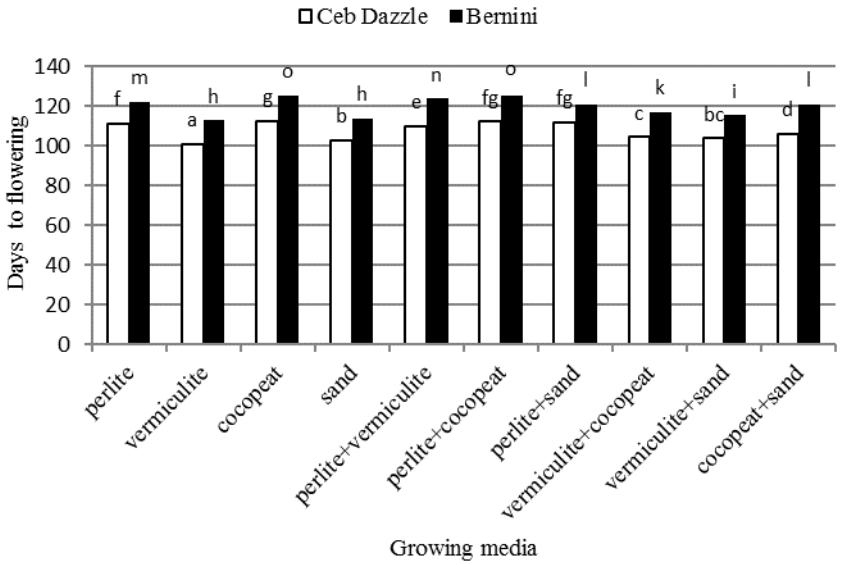

Figure 1. Effect of culture media on days to flowering of Bernini and Ceb Dazzle cultivars of the lily; Means with the same letters are not significantly different at p≤ 0.01 (Duncan's Multiple Range Test).

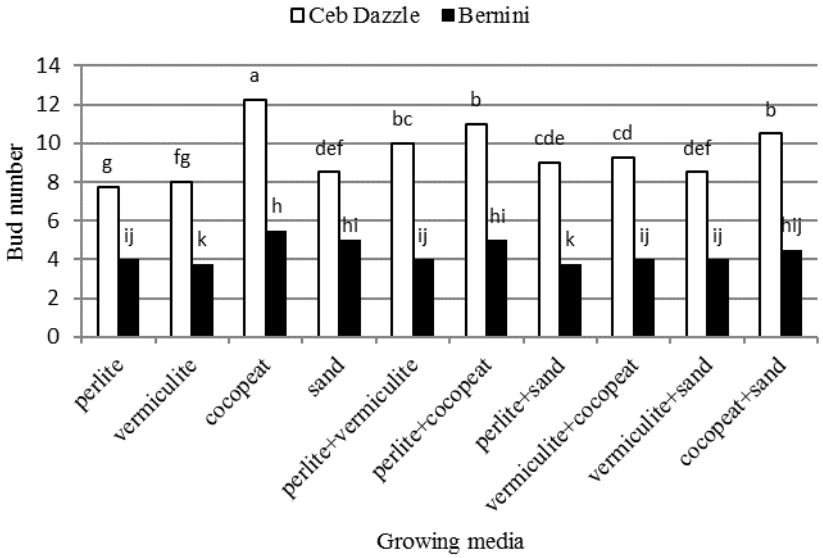

Figure 2. Effect of culture media on flower-bud number of Bernini and Ceb Dazzle cultivars of the lily; Means with the same letters are not significantly different at p≤ 0.01 (Duncan's Multiple Range Test).

and lowest flower bud number was recorded for the Bernini and Ceb Dazzle cultivars sown at cocopeat and perlite, respectively, and varied between 3.75 and 12.25 (Figure 2).

Enhanced vegetative growth which in turn affects the reproductive phase of the plants could be achieved by optimum physical (porosity, water, air retention capacity) and chemical (CEC, EC) properties of the growing medium (Yasui 1986). Blom (1999), Eleni *et al*. (2001), and Syros *et al.* (2001) indicated that porous media with higher CEC and EC had a significant and positive effect on the flower bud number of the rose bushes.

Flower number

In this study, some of the formed flower buds on the lily plants fully opened and the rate of development of the flower buds to flowers was different among the culture media. The flower number was affected significantly (p≤ %1) by the type of cultivar and it was higher in the Ceb Dazzle cultivar than the Bernini cultivar (Tables 2 and 3). The growing media had a significant effect on the flower number (Table 2) and cocopeat was the most suitable medium in terms of this trait while the lowest flower number was produced on the plants grown at the sand plus vermiculite (Table 3). The cultivar by growing medium interaction was also significant for this trait (Table 2) and the highest number of 8.5 flowers per plant was recorded in the Ceb Dazzle cultivar cultured on cocopeat while the Bernini cultivar sown on the mixture of vermiculite plus sand had the lowest mean of 2.5 flowers at the end of the experiment (Figure 3).

The flower number on lily similar to other cut flower crops is an important feature in the harvested cut flowers and their marketing. The effect of genotype and growing media on this parameter has been also reported by other

workers. Hahn *et al*. (2001) recorded more flower per plant for the gerbera cultivated on the soilless system with the perlite and vermiculite substrates as compared to cocopeat and rockwool. Syros *et al*. (2001) observed a 2-fold increase in the flower number in the hydroponic culture of rose plants grown on the cocosoil as compared to the plants cultured on the pumice substrate. They attributed this to the improvement of water and nutritional uptake by the plants in the cocosoil medium. Hernandez *et al.* (2005) indicated that the higher yield of the crops grown in cocopeat is the result of the nutritional balance caused by this substrate and its physical properties such as porosity and aeration. The superiority of cocopeat to other substrates was also emphasized by Eleni *et al.* (2001), Blom (1999), and Syros *et al.* (2001) on rose, and Mami *et al.* (2008) on tomato. Chang *et al.* (2012) observed that humic acid significantly enhanced the N content of the leaves and Zn content of the roots on lilies. Arancon *et al.* (2008) observed on the petunia that increasing the vermicomposts of the food waste to 20, 30, and 40% in the culture medium produced significantly more flowers than other amounts. Sardoei *et al.* (2014) found that a relatively higher amount of vermicompost (40, 50, and 60%) improved the growth and flower production in marigold.

Flower size

The size of the formed flowers on the lily plants was related to the plant vigor and varied among the treatments and even within the flowers of each plant. According to ANOVA (Table 2), the growing media, cultivar, and their interaction statistically ($p \leq 1\%$) influenced the flower size. The flower size of the Bernini cultivar was higher than Ceb Dazzle. Cocopeat resulted in the largest size of the flowers on both cultivars whereas the smallest size of flowers was produced on the plants cultivated at the vermiculite + sand mixture (Table 3, Figure 4). The flower sizes in the Bernini and Ceb Dazzle cultivars cultured at cocopeat were 23.5 cm and 19.6 cm, respectively (Figure 5). However, the smallest flower size was observed on the plants cultured in the sand + vermiculite for both cultivars.

Flower size is the main feature in the attractiveness and marketing of the lily cut flower, and showy and large-sized flowers are highly requested by the customers in this crop. Hahn *et al.* (2001) in the gerbera plants and Khandan *et al.* (2007) on the rose bushes of the Varlon cultivar observed that cocopeat significantly improves the flower size of these crops as compared to other culture media. Basheer and Thekkayam (2012) studied the effects of different potting substrates on *Anthurium andreanum* and found that cocopeat resulted in the highest leaf area as compared to other growing media and attributed it to the physical characteristics of cocopeat and improved nutrient composition and its ability to make nutrients available to the plants easily.

Stem length

The emerged shoots on the planted bulbs had a rapid growth and plants' height reached more than 60 cm within almost 100 days. Analysis of variance depicted that the cultivar, the growing media, and their interaction were significantly

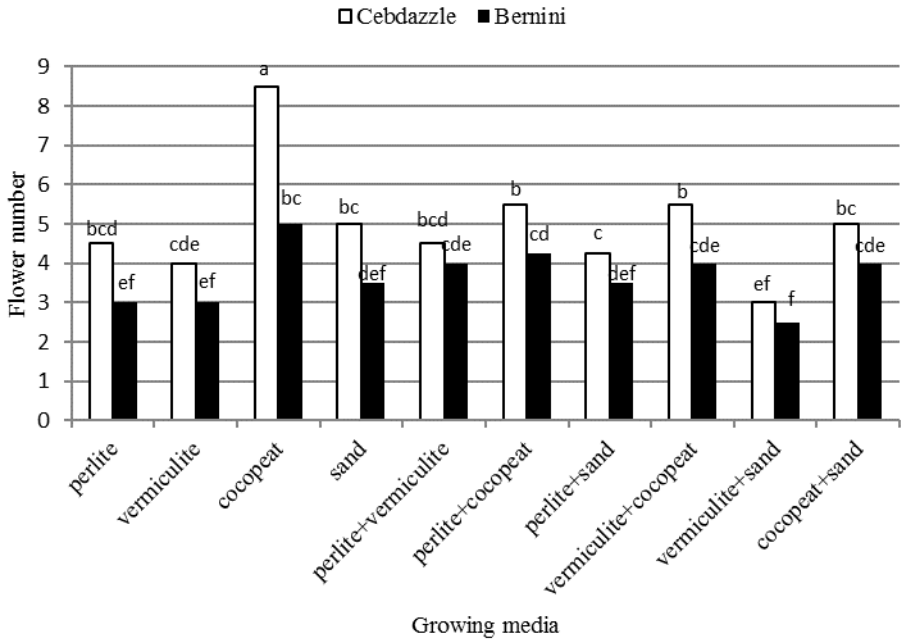

Figure 3. Effect of culture media on the flower number of Bernini and Ceb Dazzle cultivars of the lily; Means with the same letters are not significantly different at p≤ 0.01 (Duncan's Multiple Range Test).

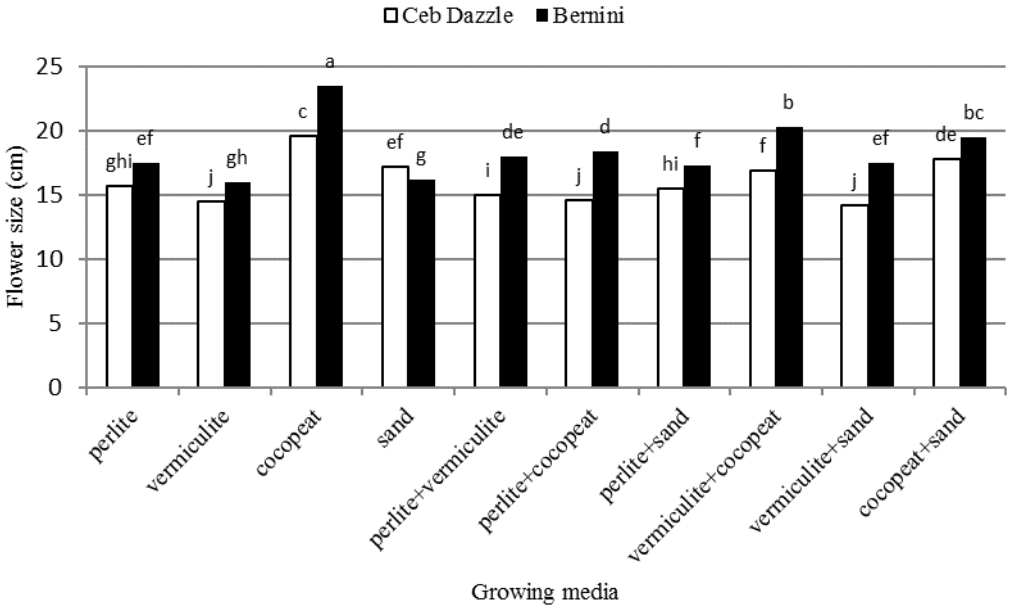

Figure 4. Effect of culture media on the flower size of Bernini and Ceb Dazzle cultivars of the lily; Means with the same letters are not significantly different at p≤ 0.01 (Duncan's Multiple Range Test).

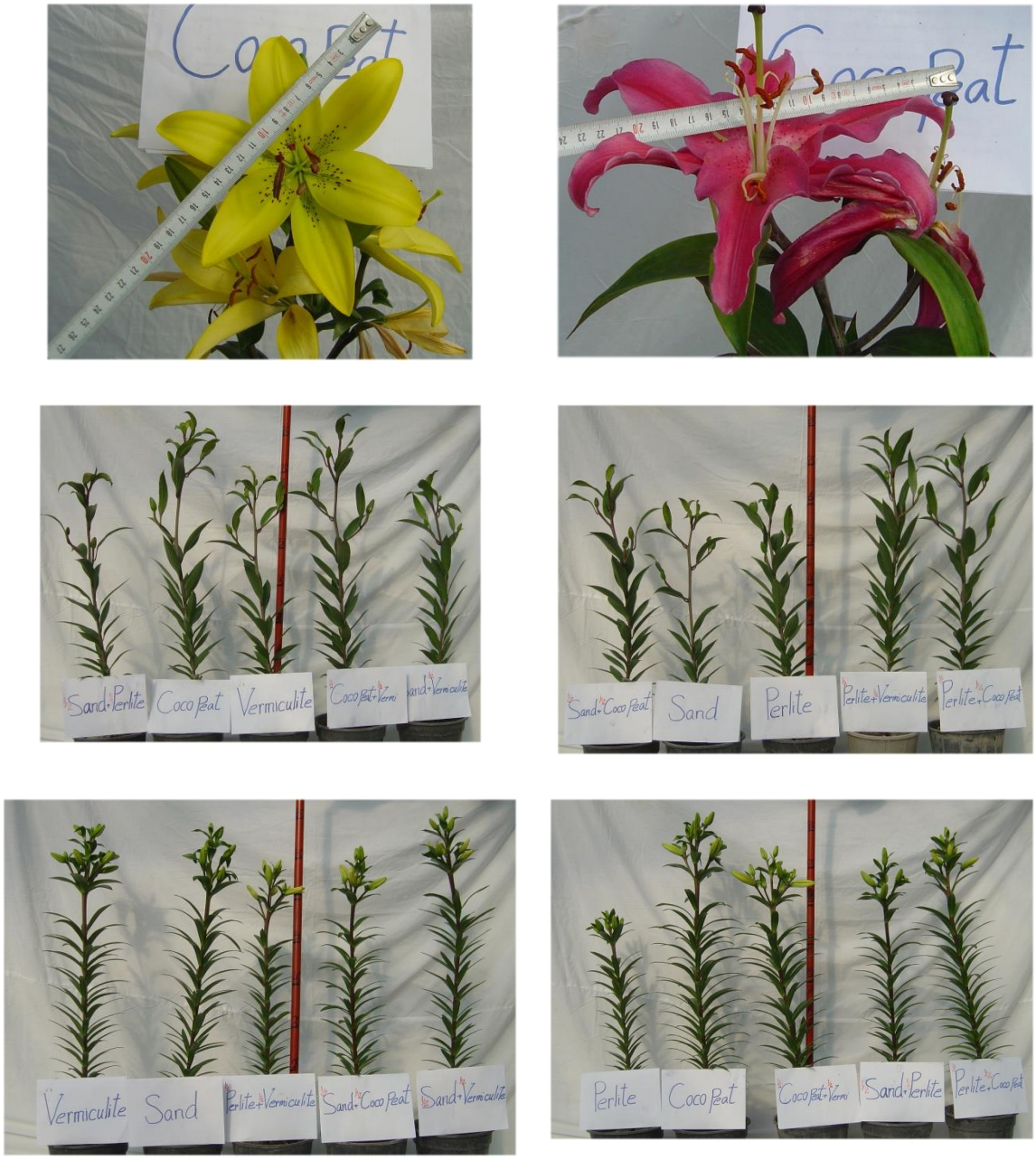

Figure 5. Top row: the maximum observed flower size in the Bernini (left) and Ceb Dazzle (right) cultivars; Middle row: the stem length of the Bernini cultivar at different media; Bottom row: the stem length of the Ceb Dazzle cultivar at different media.

($p \leq 0.01$) effective on the stem length of the treated plants (Table 2). The selected cultivars in this study had different responses to the culture media and the Bernini cultivar on average was superior to the Ceb Dazzle cultivar for this parameter (Figure 5). Cocopeat was the most

desirable substrate for the lily plants by the height mean of 109.7 cm. The tallest and shortest plants belonged to the Ceb Dazzle cultivar grown at cocopeat (113.17 cm) and the Bernini cultivar planted at the sand (69.9 cm), respectively (Figure 6).

The stem length is a valuable feature for florists which is more effective in the grading and marketing of the cut flower crops (Oki and Leith 2004). The beds with the base of organic compounds such as peat have a high cationic exchange capacity and it is 50 to 100 fold higher than in the perlite (Sonneveld and Voogt 2009). The more stable pH of the growing medium caused by the peat has direct and indirect influences on the uptake of nutritional elements. Syros *et al.* (2001) found significant differences among different media for plant height of the rose but didn't observe any significant difference in gerbera. Benito *et al*. (2005) observed that the addition of peat (maximum of 25%) promotes the growth of the plants because of the improvement in physical properties. Pool and Conover (1991) recorded the lowest height for the Dracena cultivar cultured on the sand medium due to the high porosity and lower water retention of the sand. A negative correlation was observed between the media porosity and most of the growth parameters in the house plant of *Aglaonema* (Wotton *et al.* 1981). Likewise, Eleni *et al.* (2001) reported the impact of different media on the growth and development of rose. Fascella and Zizzo (2005) found that **s**ubstrates affected the yield and quality of rose plants grown in the organic mixture and produced a higher amount of flowers than those in the inert media (17.7 and 13.6 stems/plant, respectively), as well as longer stems (65 versus 58 cm). The significant influence of culture mixture was also documented by Paradiso *et al.* (2008) using cocopeat along with perlite which improved the leaf water potential and the net assimilation and transpiration rates of the gerbera plants as compared to perlite alone due to both the higher leaf number and leaf area. They also realized that in the plants grown in the mixtures containing organic medium, the P and K contents in leaf tissues were increased.

Conclusions

This experiment confirmed that applying the cocopeat in the culture medium of lily partially or fully in the potting mixture resulted in the improvement of the growth and quality improvement of the lily crop. Despite the other crops, the growth and development of this plant enhanced even by using 100% of the cocopeat as the potting substrate. However, it is necessary to do further research about the economic value of cocopeat as the growing medium. Meanwhile, using domestically available alternative compounds such as molasses, wheat straw, and by-products of maize, canola, and other crops as the potting medium is required.

Conflict of Interest

The authors declare that they have no conflict of interest with any people or organization concerning the subject of the manuscript.

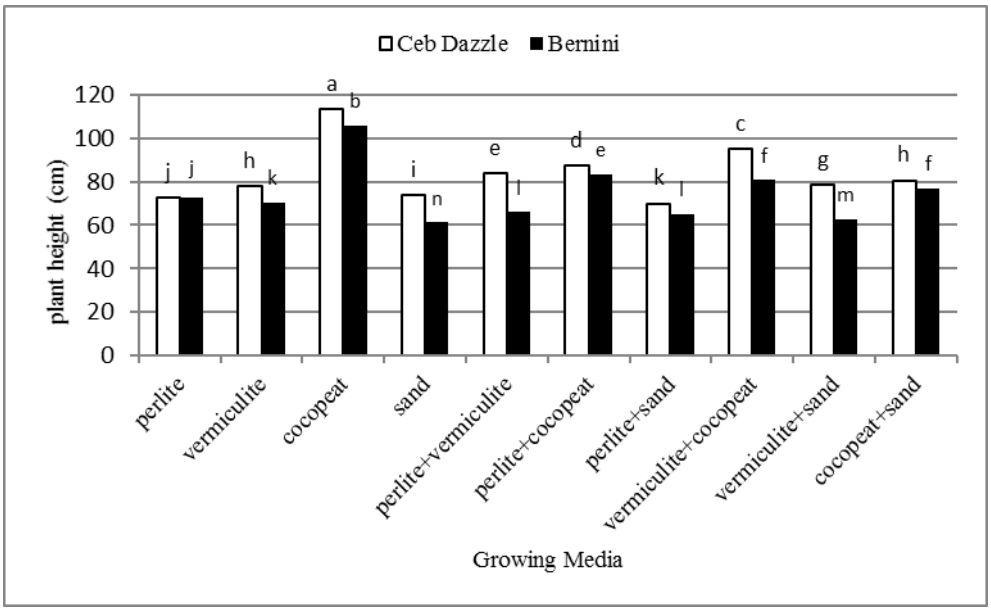

Figure 6. Effect of culture media and cultivar on the plant height of Bernini and Ceb Dazzle cultivars of lily Means with the same letter are not significantly different at $p<0.01$ (Duncan's multiple range test).

References

Arancon NQ, Edwards AC, Babenko A, Cannon J, Galvis P, and Metzger JD, 2008. Influences of vermicomposts, produced by earthworms and microorganisms from cattle manure, food waste, and paper waste, on the germination, growth, and flowering of petunias in the greenhouse. Applied Soil Ecology (39): 91-99.

Barrett GE, Alexander PD, Robinson JS, and Bragg NC, 2016. Achieving environmentally sustainable growing media for soilless plant cultivation systems – a review. Scientia Horticulturae 212: 220-234.

Basheer SN and Thekkayam SG, 2012. Effect of growing media and organic nutrition on vegetative growth in Anthurium plant (*Anthurium andreanum* cv. Tropical). The Asian Journal of Horticulture 7(2): 354-358.

Benito M, Masaguer A, De Antonio R, and Moliner A, 2005. User of pruning waste compost as a component in soilless growing media. Bioresource Tecnology 96: 597-603.

Blom TJ, 1999. Coco coir versus granulated rockwool and 'ARCHING' versus traditional harvesting of roses in hydroponic system. Acta Horticulturae 4871(2): 503-510.

Chang L, Yun W, Xu W, Nikbakht A, and Xia Y, 2012. Effects of calcium and humic acid treatment on the growth and nutrient uptake of oriental lily. African Journal of Biotechnology 11(9): 2218-2222.

Davidson H, Mecklenburg R, and Peterson C, 1998. Nursery Management: Administration and Culture. Second edition. Prentice- Hall, Inc. New Jersey, USA, 173 pp.

De Hertogh AA, 1996. Marketing and research requirements for lilium in north America. Acta Horticulturae 414: 17-24.

Eleni M, Sabri K, and Dimitra Z, 2001. Effect of growing media on the production and quality of two rose varieties. Acta Horticulturae 548: 79-83.

Fascella G and Zizzo GV, 2005. Effect of growing media on yield and quality of soilless cultivated rose. Acta Horticulturae 697: 133-138.

Gruda NS, 2019. Increasing sustainability of growing media constituents and stand-alone substrates in soilless culture systems. Agronomy 9: 1-24.

Hahn EJ, Joen MW, and Kee P, 2001. Culture method and growing medium affect growth and flower quality of several gerbera cultivars. Acta Horticulturae 548: 385-391.

Hernandez-Apolaza L, Gasco AJ, Gasco M, and Guerrero F, 2005. Reuse of waste materials as growing media for ornamental plants. Bioresource Technology 96: 125-131.

Khandan MA, Babalar M, Naderi R, and Asgari MA, 2007. The influence of different ratios of NH4 and NO3 nitrogen sources on rose (*Rosa hybrid* L. 'Varlon') cut flower production. Iranian Journal of Horticultural Sciences and Techniques 8(3): 139-148 (In Persian with English abstract).

Larson AR, 1992. Introduction to Floriculture. 2nd ed. Academic Press Inc., USA.

Magnani G, Grassotti A, and Nesi B, 2003. Lapillus growing medium for cut bulbous flowers in soilless culture. Acta Horticulturae 609: 389-393

Mami Y, Peyvast Gh, Bakhshi D, and Samizadeh H, 2008. Effect of different substrates on tomato production in soilless culture. Journal of Horticulture Science 2(2): 39-48 (In Persian with English abstract).

Menzies NW and Aitken RL, 1996. Evaluation of fly ash as a component of potting substrates. Scientia Horticulturae 67: 87-99.

Montagne V, Capiaux H, Cannavo P, Charpentier S, Renaud S, Liatard E, Grosbellet C, and Lebeau T, 2016. Protective effect of organic substrates against soil-borne pathogens in soilless cucumber crops. Scientia Horticulturae 206: 62-70.

Oki LR and Leith JH, 2004. Effect of change in substrate salinity on the elongation of *Rosa hybrida* L. Scientia Horticulture 101-103.

Paradiso R and De Pascale S, 2008. Effects of coco fibre addition to perlite on growth and yield of cut gerbera. Acta Horticulturae 779: 529-534.

Pool RT and Conover CA, 1991. Potential for eucalyptus mulch used as a component of potting mixes for foliage plant production. CFREC-Apopka Research Report, RH-91-13, Central Florida Research and Education Center, University of Florida, Apopka, Florida, USA.

Sardoei AS, Roien A, Sadeghi T, HahadadiF, and Mokhtari TS, 2014. Effect of vermicompost on the growth and flowering of African marigold (*Tagetes erecta*). American-Eurasian Journal of Agricultural and Environmental Sciences 14: 631-635.

Sonneveld C and Voogt W, 2009. Plant Nutrition of Greenhouse Crops. Springer, Germany, pp. 237.

Syros T, Econormou A, Galafis A, Tsicreitsis G, and Ralli P, 2001. A comparative study of rose cultivation of coco-soil and pumice with recirculation of the nutrient solution. Acta Hort. 548: 503-510.

Syros T, Economou A, Orliaklis GM, Tsicritsis G, Exarchou E, and Schmidt U, 2001. Flower and growth evaluation of gerbera cultivation on perlite in an open hydroponic system. Acta Horticulturae 548: 625-630.

Wilson SB, Muller KL, Chris Wilson P, Incer MR, Stoffella PJ, and Graetz DA, 2009. Evaluation of new container media for *Aglaonema* production. Communications in Soil Science and Plant Analysis 40: 2673-2687.

Worrall RG, 1981. Comparison of composted hardwood and peat-based media for the production of seedlings, foliage and flowering plants. Scientia Horticulturae 15: 311-319.

Wotton RD, Gouin FR, and Stark FC, 1981. Composted digested sludge as a medium for growing flowering annuals. Journal of the American Society for Horticultural Science 106(1): 46-49.

Yasui H, 1986. Characteristic of a new culture media and use. New Technology of Hydroponic Culture 6: 15-20.

اثرات بسترهای کشت بر زمان گلدهی و خصوصیات مهم تجاری گل بریده سوسن (لیلیوم) در کشت بدون خاک

سعداله علیزاده اجیرلو[1*]، رامین نیک رزم[2]، احمد خلیقی[3] و سید جلال طباطبایی[4]

۱- گروه مهندسی فضای سبز، دانشگاه تبریز، تبریز
۲- دانشجوی سابق کارشناسی ارشد، دانشگاه آزاد اسلامی، واحد علوم و تحقیقات، تهران
۳- دانشگاه آزاد اسلامی، واحد علوم و تحقیقات، تهران
۴- گروه علوم باغبانی، دانشگاه شاهد، تهران
*مسئول مکاتبه؛ Email: azajirlo@tabrizu.ac.ir

چکیده

تاثیر چند نوع بستر مختلف آلی و معدنی در کشت هیدروپونیک روی برخی صفات کمی و کیفی گل بریده لیلیوم مورد بررسی قرار گرفت. آزمایش در قالب فاکتوریل بر پایه طرح کاملا تصادفی با استفاده از ده بستر کشت و رقم‌های "برنینی" (اوریانتال) و "سبدازل" (آسیاتیک) در چهار تکرار انجام شد. بسترهای مختلف آلی و معدنی عبارت بودند از: ماسه، ورمی کولیت، پرلیت، کوکوپیت و بسترهای ترکیبی دو به دو آن‌ها با نسبت‌های حجمی مساوی (۵۰:۵۰). تمامی گلدان‌ها بعد از یک هفته از کاشت پیازها هر روز و به طور یکنواخت و با ۲۵۰ میلی لیتر محلول غذایی فرمول هوگلند تغذیه شدند. رشد و نمو گیاهان در کلیه واحدهای آزمایشی ثبت گردید. نتایج نشان داد که کوکوپیت به عنوان بستر کشت از لحاظ تسریع زمان گلدهی، تعداد غنچه در هر بوته، تعداد گل کامل در هر بوته، قطر گل و ارتفاع ساقه گل دهنده در هر دو رقم بر سایر بسترهای کاشت برتری داشت. کوتاه‌ترین زمان برای گلدهی در بستر ماسه برای رقم "برنینی" و در بستر ورمی کولیت برای رقم "سبدازل" مشاهده شد. استفاده از بسترهای حاوی کوکوپیت (۵۰ و ۱۰۰ درصد) به تولید جوانه گل و گل بیشتر، اندازه بزرگتر گل و ارتفاع بیشتر گیاهان در مقایسه با سایر بسترها منجر شد.

واژه‌های کلیدی: بستر کشت؛ خصوصیات گل؛ زمان گلدهی؛ سوسن؛ کشت بدون خاک