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Research Article

USABILITY OF LAVANDULA STOECHAS IN SOME VERTICAL GARDEN SYSTEMS

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ABSTRACT. Increasing migration from rural areas to urban areas has led to an increase in the rate of urban construction and a decrease in open green spaces. Vertical gardens are one of the alternative methods that can be used to increase open green spaces. This study was conducted to determine the cultivation possibility of *Lavandula stoechas* L. in some vertical garden systems. The experiment was set up with 3 replications according to the randomized plot design. There were 24 plants in each replication. *Lavandula stoechas* plants were grown in felt system, modular panel system, hydroponic system and horizontal system (control) for 12 weeks. Plant growth was detected in all systems. At the end of the fourth week, the highest plant height was achieved in the horizontal system (10.33 cm), the modular panel system (9.67 cm) and the felt system (9.00 cm). At the end of the 8th and 12th weeks, there was no difference between the treatments in terms of plant heights. At the end of the 4th and 12th weeks, the plant diameter was high in the horizontal system and modular panel system, and no difference was detected at the end of the 12th week. The root length changed between 26.53 cm and 27.57 cm.

Keywords: *Lavandula stoechas*, French lavender, vertical garden, cultivation, ornamental plants

INTRODUCTION

In the 21st century, where the human population is increasing, the population in rural areas decreased with migration to the cities but increased in urban areas. The increase in population density in urban areas has caused many environmental problems [1]. The usage of natural resources to meet energy needs, destruction of forest areas, global climate change, increased urban heat island effect, and the decrease of urban biodiversity are among the main environmental problems [2]. As a result of the increasing population, cities have largely become concrete piles, urban open-green areas have been destroyed and even to the point of extinction [3]. In recent years, environmental awareness has begun to increase to prevent environmental problems getting worse in urban areas several technologies have been developed that will provide sustainable urban living models and positive effects on the urban environment. Vertical gardens are among these technologies [4].

Vertical garden is the cultivation of some plant species used in landscape applications in containers on the vertical plane. [5]. Vertical garden plays a good role in

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reducing the heat island effect in cities, reducing energy loss with the insulation effect and the indirect shading effect from the use of plants [6]. At the same time, these systems have positive environmental contributions such as reducing noise pollution in cities, preventing water loss, increasing air quality, protecting and increasing biodiversity [7]. The vegetation of the urban natural landscape gives information about the city's soil structure and geomorphology, climate characteristics, hydrological structure and land use structure. These plants can be used in landscape applications. *Lavandula stoechas* L., which grows naturally in the Izmir region, is one of the species that can be used in landscape applications. [8].

Lavandula stoechas L. (French lavender) plant belongs to the *Labiateae* family and popularly known as “Blackhead grass” in Anatolia [9]. *Lavandula stoechas* L. species grows between 40-50 cm in height, prefers in soils with pH values of 5.8 and 8.3, requires less water, grows in narrow and limited areas [10]. *Lavandula stoechas* L. plant, which is generally grown in the Mediterranean basin, has medicinal importance. It is used in the treatment of some diseases in traditional medicine. Thanks to the essential oil in its flowers, it is also used in the cosmetics industry [11].

This study was conducted to determine the cultivation possibility of *Lavandula stoechas* L. in some vertical garden systems.

MATERIALS AND METHODS

The study was carried out from March 5, 2021 to June 5, 2021 on the balcony wall of a private apartment in the Yenigün Neighbourhood of Buca district, Izmir province (Fig. 1). During the trial period, the average temperature of the trial area was 19 °C, the average rainfall was 46 mm, the average wind speed was 5.5 km/h, and the average humidity was 65% [12]. French lavender saplings propagated by cutting in the private nursery were used as plant material in the experiment (Fig. 2). Before planting, it was found the average sapling height was 4.58 cm, sapling diameter was 4.43 cm, root length was 6.91 cm.

First of all, the growing containers for planting saplings in the felt system, modular panel system, hydroponic system were prepared vertically in the form of 4 rows x 6 columns in each parcel. Secondly French lavender saplings were planted the prepared growing containers filled with a growing media of 50% peat and 50% perlite (by volume) in the felt system and modular panel system. After that, In the hydroponic system, the saplings were planted in bottles with a volume of 300 ml. Last, the saplings in the horizontal system were planted in a plastic crate filled with growing media in the form of 4 rows x 6 columns in each parcel. French lavender saplings were grown in felt system, modular panel system, hydroponic system vertically and horizontal system (control) during 12 weeks. Plant feeding and irrigation was done manually. The experiment was set up with 3 replications according to the randomized plot design. There were 24 saplings in each replication and a total of 288 saplings were used for the whole experiment. To determine the development of *Lavandula stoechas* plant grown in different systems; plant height, plant diameter, leaf width, leaf length and root length, root weight were measured. Variance analysis (ANOVA) and Duncan multiple comparison tests (p=0.05) were applied to the obtained data with SPSS 26 program.

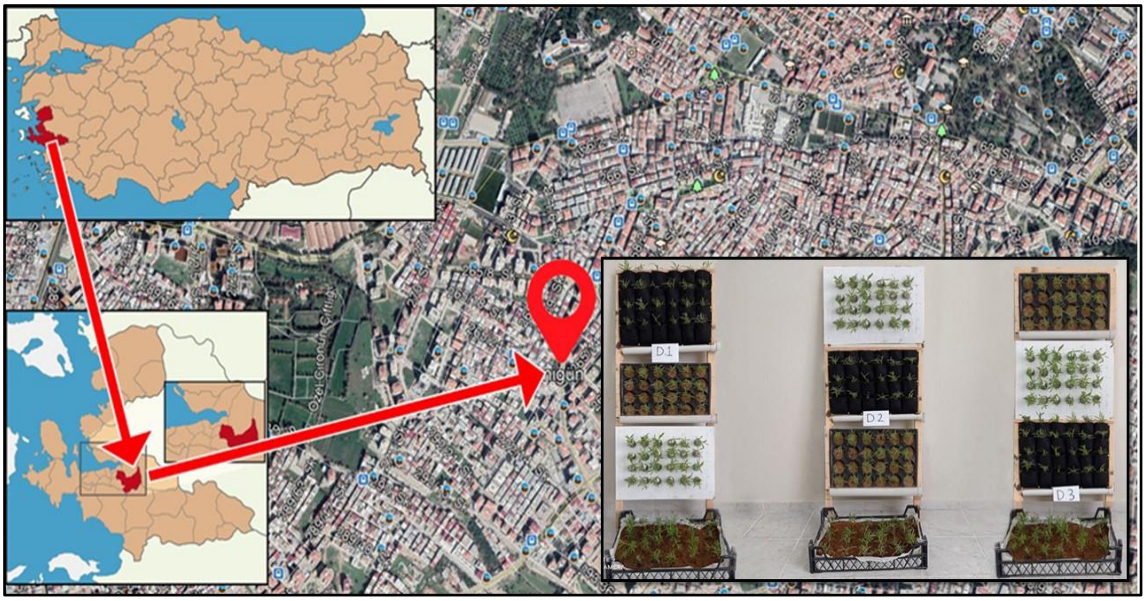


Fig. 1. *Working area*



Fig. 2. *French lavender* sapling used in the experiment

RESULTS AND DISCUSSION

The growth and development of the plants continued normally for 12 weeks. Plant height increased from planting to the end of the experiment in all systems (Fig. 3). According to the statistical analysis, at the end of the 4th week, the highest plant height was achieved in the horizontal system, modular panel system and felt system. At the end of the 8th and 12th weeks, there was no statistical difference between the systems in terms of the plant height. At the end of the experiment, the plants reached a height of 35 cm to 37.5 cm. Orhan [13] stated that the plant height of *Lavandula stoechas* was between 40-50 cm. Since the plants in the study did not reach full maturity, they were lower than these values. They can reach this size when they grow for a longer period.

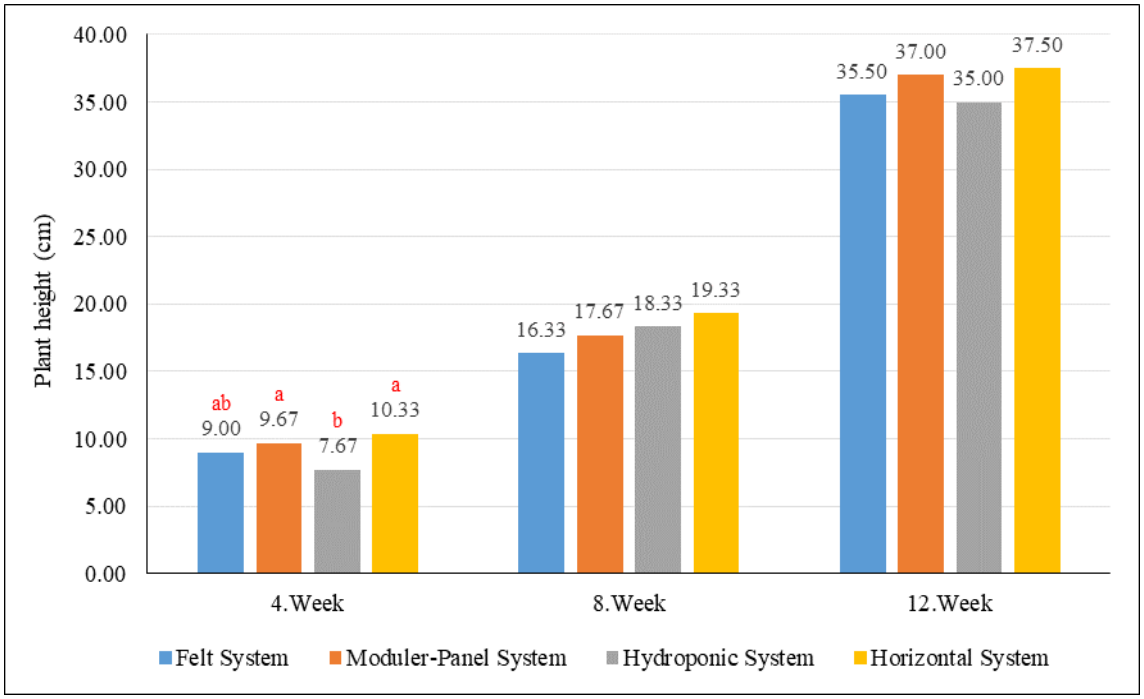


Fig. 3. *Plant height during the growing period.*

At the end of the 4th and 8th weeks, there was a statistical difference between the systems in terms of plant diameter. At the end of the 4th week, the highest plant diameter was in the horizontal system and modular panel system (Fig. 4). At the end of the experiment, the numerically largest plant diameter value was 29 cm. The plant diameter values of *Lavandula stoechas* varied between 30-50 cm [14]. In the study, the results close to these values were obtained. The plant diameter increased in all systems until the end of the experiment.

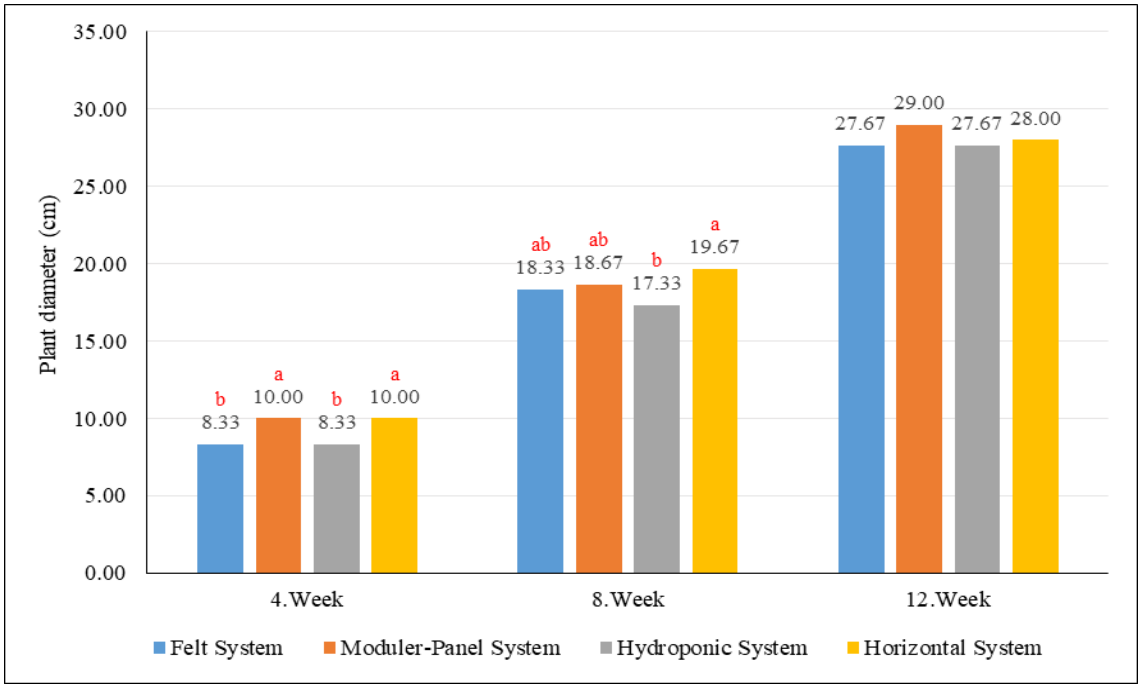


Fig. 4. *Plant diameter during the growing period.*



Fig. 5. *Appearance of plants according to the growing systems.*

The effect of the systems on leaf width was found to be statistically insignificant. At the end of the experiment, it was observed that the leaf width values of the plants varied between 5.03 mm and 5.27 mm (Fig. 6). Internet access [15] described the leaf width values of *Lavandula stoechas* between 1 mm and 5.5 mm. The results obtained were between the above values.

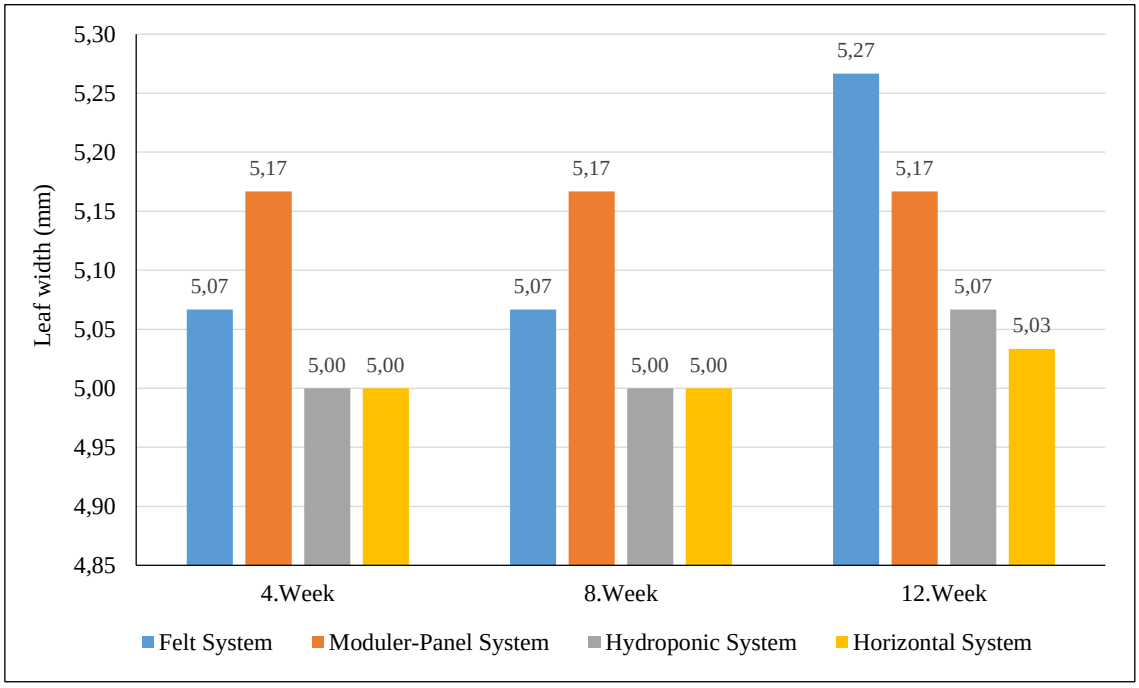


Fig. 6. *Leaf width during the growing period.*

The leaf length increased from planting to the end of the experiment (Fig. 7). However, there was no difference between the treatments in terms of the leaf length. It was found that the leaf length ranged from 4.17 cm to 4.30 cm at the end of 12. week. Senol and Sogüt [16] examined the possibilities of using succulents (*Rosularia libanotica, Sedum sediforme, Sedum compressum)* that grow naturally around Kozan Castle in vertical garden systems. They stated that the leaf lengths of the plants were longer in open area than the greenhouse. In Internet access [15] the leaf length values of *Lavandula stoechas* plant were between 1.5 cm and 4.5 cm. Similar results were obtained from the experiment.

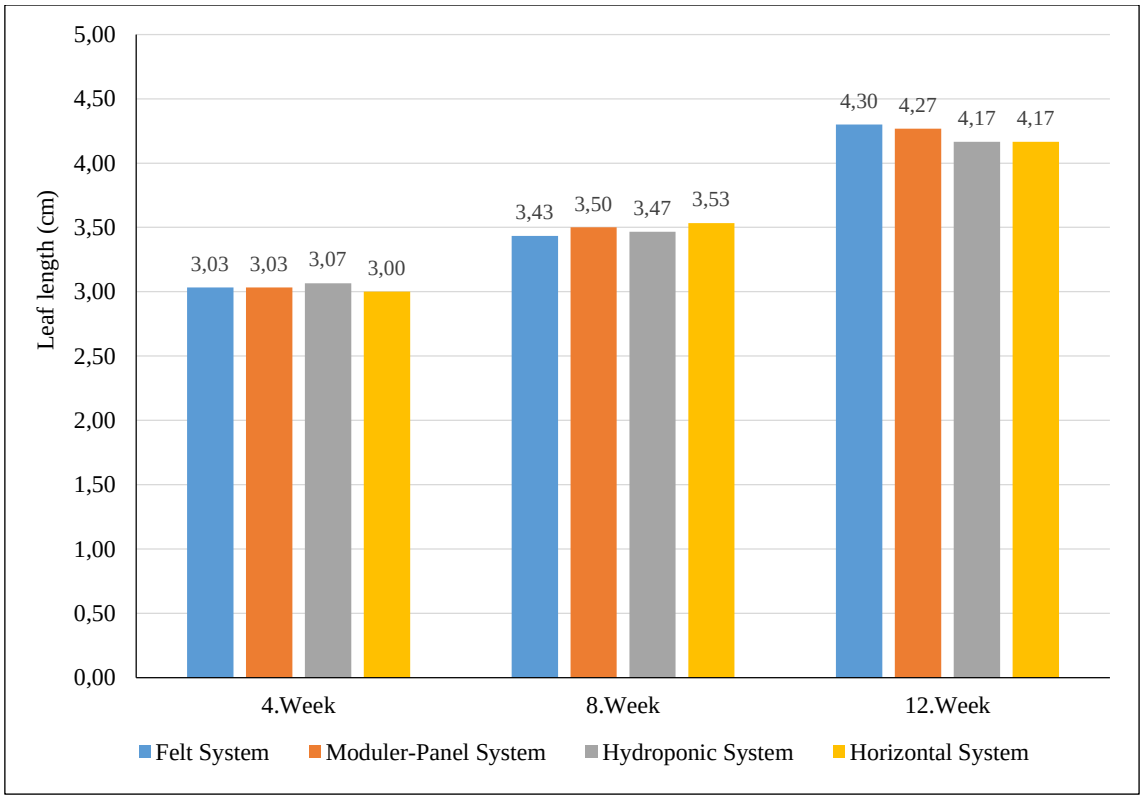


Fig. 7. *Leaf length during the growing period.*

At the end of the 12th week, it was determined that the root length changed between 26.53 cm and 27.57 cm (Fig. 8). Ayanoglu et al. [17] investigated the effect of different locations and hormone doses on the rooting of *Lavandula stoechas* with cuttings. In their study, they found that the most effective IBA level in rooting plants was 4000 ppm and the longest root length was 11.12 cm. The root length before planting was close to these values.

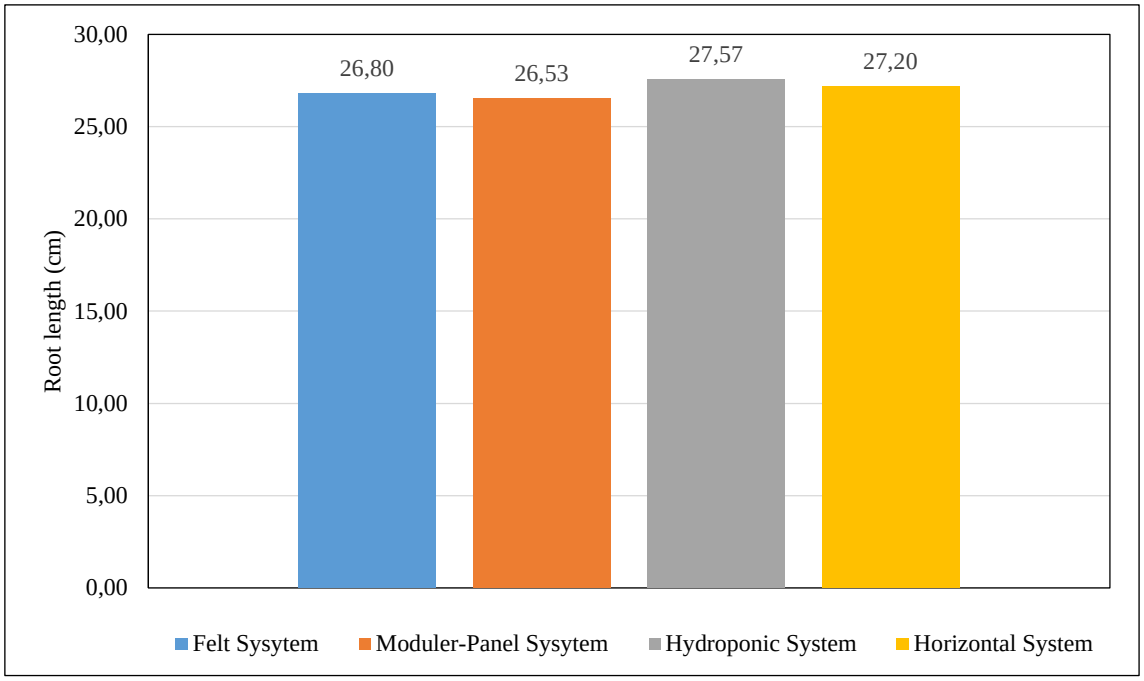


Fig. 8. *Root length at the end of the experiment*

According to the analysis of variance, the effect of growing systems on the root weight was found to be insignificant. The root weight values ranged from 23.67 g to 24.83 g. Lopez [18] stated that the fresh root weight values of *Lavandula stoechas* in different growing media varied between 23.2 g and 38.7 g. The root weight values in this study show parallelism with the values in Lopez's study.

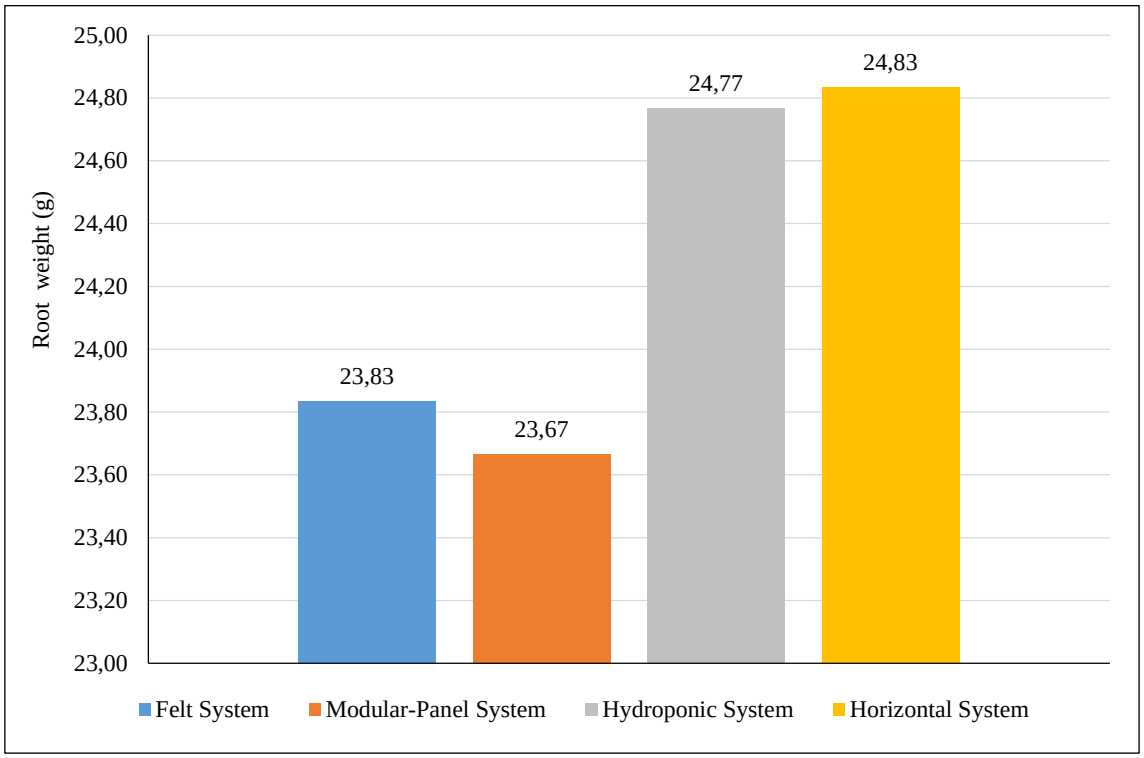


Fig. 9. *Root weight at the end of the experiment*

CONCLUSIONS

Increasing world population, migration from rural areas to urban areas and industrialization have led to a decrease in open green areas. Instead of open green areas, residences, workplaces and industrial areas were built. Apart from the limited open spaces in cities, new green areas that can be created in existing buildings can be possible with vertical garden applications. With the selection of plants suitable for the urban climate, the sustainability of plant cultivation on vertical surfaces can be achieved in vertical gardens. The use of natural plant species in urban areas will further facilitate the adaptation of plants to vertical garden systems. In this study, *Lavandula stoechas* L. plants spreading in İzmir natural vegetation were grown in felt system, modular panel system, hydroponic system and horizontal (control) system for 12weeks. Plants developed normally in both horizontal and vertical growing systems during this period.The plant diameter having the feature of covering the area in vertical gardens was different between the systems at the end of the 4^{th} and 8^{th} week.Visually, the plant diameter and plant height are similar in all growing systems.When all the parameters are evaluated together, Lavender can be grown as an alternative plant in vertical garden systems. In further studies, it will be useful to investigate other alternative plants that can be used in vertical gardens.

NOTE

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REFERENCES

[1] Félix, M. J., Santos, G., Barroso, A., Silva, P. (2018): The transformation of wasted space in urban vertical gardens with the contribution of design to improving the quality of life. International Journal for Quality Research, 12(4): 803-822.

[2] Özdemir, Z., Özekicioğlu, H. (2006): Urbanization and environmental problems. Journal of the Faculty of Economics and Administrative Sciences of Süleyman Demirel University, 11(1); 17-30.

[3] Eroglu, E., Basaran, N. (2017): Evaluation of Visual Landscape Quality of Interior Vertical Garden Plant Compositions. Duzce University Faculty Of Forestry Journal Of Forestry, 13(2): 32-49.

[4] Pérez, G., Coma, J., Martorell, I., Cabeza, L. F. (2014): Vertical Greenery Systems (VGS) for Energy Saving in Buildings: A Review. Renewable and Sustainable Energy Reviews, 39: 139-165.

[5] Gür, N., Kahraman, O. (2020): Vertical Garden Applications and Potential Areas in Izmir City Center Public Spaces. 9. International Scientific Research Congress, 12-13 December 2020, Ankara.

[6] Wong, N.H., Tan, A.Y.K., Tan, P.Y., Wong, N.C. (2009): Energy Simulation of Vertical Greenery Systems. Energy and Buildings, 41(12): 1401-1408.

[7] Çerçi, S. (2018): Environmental and Ecological Effects of Vegetated Facades. 9. National Roof & Facade Symposium, 12-13 April 2018, Istanbul.

[8] Bayraktar, A. (1980): Researches on the Detection of Some Natural Plant Species in the Green Cover of Izmir and Its Surroundings and Their Use in Landscape Studies. Turkish Landscape Architecture Association Publications, 1980(2): 5-57.

[9] Oztürk, B., Konyalıoglu, S., Kantarcı, G., Cetinkol, D. (2005): Wild Lavandula stoechas L. subsp. Composition of Essential Oil Obtained from Stoechas Taxon, Antibacterial, Antifungal and Antioxidant Capacity. Journal of Anatolia Aegean Agricultural Research Institute, 15(1): 61-72.

[10] Goto, M., Otles, S., Askin, R. (2005); Supercritical extraction of black basil (Lavandula Stoechas ssp.). Academic Food, 3(1): 26-30.

[11] Gören, A. C., Topcu, G., Bilsel, G., Bilsel, M., Aydogmus, Z., Pezzuto, J. M. (2002): The Chemical Constituents and Biological Activity of Essential Oil of Lavandula stoechas ssp. stoechas. Zeitschrift für Naturforschung C, 57(9-10): 797-800.

[12] MGM, 2021. General Directorate of Meteorology, March 2021- June 2021 Izmir Meteorology Station data, Izmir, Turkey.

[13] Orhan, S. (2007). Cultivation of Black Head Grass (Lavandula Stoechas L.) Plant in Different In Vitro Nutrient Media. Master Thesis. Aegean University Graduate School of Natural and Applied Sciences Department of Bioengineering, Izmir, Turkey.

[14] Internet access. (2021): Lavandula stoechas https://www.gardenersworld.com/plants/lavandula-stoechas/ (Date of access: 10.08.2021).

[15] Internet access, (2020): Lavandula stoechas. https://kocaelibitkileri.com/lavandula-stoechas/ (Date of access: 05.07.2021).

[16] Senol, D., Sogüt, Z. (2017): Possibilities of Using Succulents Growing on Rocks in Kozan Castle in Vertical Gardens. Mediterranean Agricultural Sciences, 30(1): 7-13.
[17] Ayanoglu, F., Mert, A., Kaya, A. (2000): The Effect of Different Locations and Hormone Doses on Rooting of Blackhead Lavender (Lavandula stoechas subsp. stoechas L.) Growing in the Flora of Hatay with Cuttings. Turk J. Agric. Forest, 24: 607- 610.
[18] Lopez, D., Carazo, N., Boardas J. (1993): Growth of four native Lavandula species in different substrates. ISHS Acta Horticulturae 342: International Symposium on Horticultural Substrates other than Soil in situ.