International Journal of Agriculture, Environment and Food Sciences 2026; 10 (1):125-131 Research Article

https://doi.org/10.31015/jaefs.2026.1.14 https://izlik.org/JA42JS82LD

Effect of different growth media on some agromorphological features of (*Brassica oleracea* L. var. *capitata subvar. rubra*) microgreens

Akyamina Karakış[1] | Damla Deniz[1] | Funda Eryılmaz Açıkgöz[1] | Figen Taşcı Durgut[2] | Fatma Funda Özdüven[1]

[1]Tekirdağ Namık Kemal University, Technical Sciences Vocational School, Plant and Animal Production Department
[2]Tekirdağ Namık Kemal University, Technical Sciences Vocational School, Machinery and Metal Technologies Department

Corresponding author: Funda Eryılmaz Açıkgöz, **E-mail:** feryilmaz@nku.edu.tr

Received: December 5, 2025 | **Accepted:** January 21, 2026 | **Published Online:** March 17, 2026 | **Final Version:** March 22, 2026

Abstract

Microgreens are innovative products in the vegetable sector. Despite their short growth cycle, commercial production of microgreens requires special attention and the choice of growing medium represents one of the most critical aspects of the production process. The growth medium constitutes one of the main costs of production and plays an important role in determining the yield and quality of microgreens, as well as the environmental sustainability of the production process. The growth medium used must have a microporous structure, provide sufficient water retention capacity and adequate aeration, and be microbiologically safe. The production conditions in the research using a microgreens growing cabinet (confetti cabinet) used controlled conditions. Accordingly, the confetti cabinet was set to 16/8 light/dark photoperiod with constant temperature 22±2°C, constant humidity 70% and maximum 400 ppm CO_2 fixed values. The microgreen species used in the research was red cabbage (*Brassica oleracea* L. *var. capitata subvar. Rubra*) from the Brassicaceae family. The growth medium materials used for the germination of seeds were white germination sponge (WGS), black germination sponge (BGS), cellulose fabric (CF). Microgreens grown in the microgreen cabinet were harvested 9 days after seed sowing. Some agromorphological values were examined in the study. In terms of number of plants per cm^2, values were CF 7.60; WGS 7.43 and BGS 6.23. When the trunk length was examined, values were CF 5.77 cm; WGS 5.27 cm and BGS 3.13 cm. When the dry weight was examined, values were CF 2.31 g, WGS 1.42 g and BGS 0.99 g. When the fresh weight was examined, values were measured as CF 28.16 g; WGS 17.54 g and BGS 7.65 g. Although there was no significant difference between them according to $p<0.05$, cellulose fabric can be recommended for use in the Confetti Cabin for microgreen cultivation in terms of the examined criteria. It is important to pay attention to potential sources of microbial pollution in microgreen cultivation. In addition to the use of clean seeds in production using cellulose fabric, it is thought that the growth media should not be a potential source of microbial contamination for microgreens.

Keywords: Edible Microgreens, Growing Media, Environmental Sustainability, Controlled Environment, Automation

INTRODUCTION

Microgreens are innovative products in the vegetable sector. Microgreens are generally harvested 7-21 days after germination, when cotyledon leaves are fully developed whether a small pair of true leaves has emerged or not. Used increasingly as an edible garniture, microgreens are among minor vegetables with increasing popularity around the world due to high content of bioactive compounds (Roe, 2006; Treadwell et al., 2010; Xiao et al., 2012; Di Gioia et al., 2015a). With the development of the rapid urban agricultural industry in the world, interest in commercial production of microgreens is increasing (Di Gioia et al., 2015b; Di Gioia et al., 2017).

In spite of short growth cycle, in addition to the use of clean seeds in production, growth media are considered to form a potential source of microbial contamination for microgreens. Commercial production of microgreens requires special attention and selection of growth medium represents one of the most critical aspects of the production process as it may

Citation: Karakis, A., Deniz, D., Eryilmaz Acikgoz, F., Tasci Durgut, F., Ozduven, F.F. (2026). Effect of different growth media on some agromorphological features of (*Brassica oleracea* L. var. *capitata subvar. rubra*) microgreens. International Journal of Agriculture, Environment and Food Sciences, 10 (1): 125–131. https://doi.org/10.31015/jaefs.2026.1.14

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution 4.0 International License (CC BY 4.0). https://creativecommons.org/licenses/by/4.0/
Copyright © 2026 by the authors.

affect yield and quality. Peat is the most common environment used for microgreen production. However, it is expensive in countries without peat resources, and continuous removal represents a risk. There is a search for an organic and renewable resource as an alternative to peat (Abad et al., 2001; Muchjajib et al., 2015; Di Gioia et al., 2017; Cicek and Yücedag, 2021). Among other growth media, perlite, vermiculite and rockwool and other similar inorganic materials may be used for microgreen production. However, these environments are expensive, production requires energy and contamination problems may be experienced with the harvested plants. The most important thing in production is infestation with peat at the root crown and stem of these plants, which are harvested by cutting at the root crown. In microgreen cultivation, potential sources of microbial pollution are important elements that require care. The growth medium comprises one of the main costs of production and plays an important role in determining the environmental sustainability of the production process, in addition to the yield and quality of the microgreens (Murphy et al., 2010; Choi et al., 2015; Di Gioia et al., 2015c; Di Gioia et al., 2017). Though no food-derived outbreak has been observed related to the consumption of microgreens, there are great concerns about the clean food safety of microgreens. Contaminated seeds were observed to systematically contaminate all microgreens (Xiao et al., 2014a; Xiao et al., 2014b; Xiao et al., 2015; Di Gioia et al., 2017).

For the medium used to ensure adequate water-holding capacity and adequate ventilation, 55-70% of the total volume is recommended for microporous environments and 20-30% of the total volume for macroporous environments. The pH of the environment should be 5.5-6.5, with electrical conductivity below 0.5 dS m^{-1} and it should definitely be microbiologically safe (Abad et al., 2001; Gioia et al., 2017).

The ideal growth medium for microgreen production should be locally available, based on the use of relatively low cost, cheap and sustainable growth media.

In line with this, this research was performed with the aim of answering the following two questions:

1. To identify the useability of different color sponges and cellulosic cloth materials as growth media for microgreen production
2. To identify the effects of the growth media used in the research on some agromorphological features of microgreens.

MATERIAL AND METHOD

The research was conceptualized around cultivation under controlled conditions in a microgreen plant cultivation cabinet (confetti cabin), previously designed and produced by teaching staff from the Technical Sciences Vocational School, Plant and Animal Production Department as the research output of a university-industry cooperation. The microgreen plant cultivation cabinet was developed as the result of a project involving university-industry cooperation called "Manufacture of a fully-automated prototype microgreen plant cultivation cabinet and assessment of growth medium performance" supported by Tekirdağ Namık Kemal University Scientific Research Project "NKUBAP.42.GA.22.356" and is also a device with patent application number 2023/004164 and application date 14.04.2023 (Figure 1). The plant cultivated as microgreens was red cabbage from the *Brassicaceae* family (*Brassica oleracea* L. var. *capitat*a *subvar. rubra*). Open-pollinated local standard varieties from the Bursa® seed company were used. The growth medium materials used for germination of seeds were white germination sponge (WGS) (Figure 2), black germination sponge (BGS) (Figure 3) and cellulose fabric (CF) (Figure 4). The sponges used are 3 mm thick polyethylene foam. The production material used for the germination of seeds was placed on black perforated microgreen trays with 51 x 31 cm dimensions.

Figure 1. Microgreen cultivation cabinet (confetti cabin)

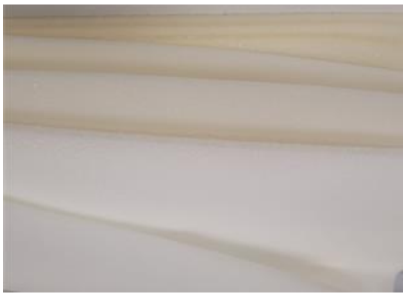

Figure 2. White germination sponge

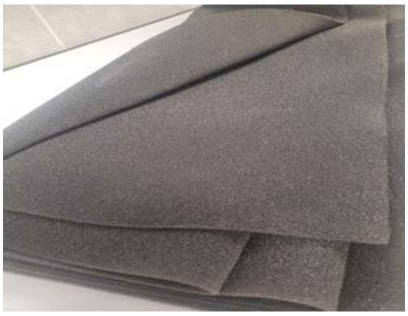

Figure 3. Black germination sponge

Figure 4. Cellulose fabric

Methods used within the scope of the research

The three production materials used for germination of seeds were placed on trays used in the research. The three production materials were placed side-by-side on each tray. The plot pattern is given in Table 1. Microgreen cabinet experimental design. (white germination sponge (WGS) (Figure 2), black germination sponge (BGS) (Figure 3), cellulose fabric (CF) (Figure 4)) The production materials placed on the trays were seeded to create a confetti of microgreens and then irrigated (Figure 5). The following conditions were also used for irrigation: pH: 7.82; electrical conductivity (EC): 603 µS/cm (initial and later stages).

Table 1. Microgreen cabinet experimental design

	1st repeat	**2nd repeat**	**3rd repeat**
CABINET	WGS	BGS	CF
	BGS	CF	WGS
	CF	WGS	BGS

Figure 5. Microgreen cabinet experimental design in tray (Bursa® seed company, red cabbage)

The research was set up with 3 repeats according to a randomized plot pattern (Düzgüneş et al., 1987). The production conditions in the microgreen cultivation cabinet ensured controlled conditions. There were 16/8 light/dark photoperiods with fixed temperature of 22±2 °C, a fixed relative humidity of 70% and maximum 400 ppm CO_2 (Figure 6).

Figure 6. Confetti cabin setup

The microgreens cultivated in the microgreen cabinet were harvested 9 days after seeding. Harvesting was completed with sharp sterile scissors, cutting the plant at the root crown region. The harvested plants were weighed on a scale with 0.01 g sensitivity for fresh weight. The stem length (cm) was measured with a ruler from the root crown on the vertical axis of the plants to the start of the cotyledon. The number of plants per cm^2 was determined by counting the number of plants in a 5 cm^2 area and dividing to calculate the number in 1 cm^2 (Figure 7).

Figure 7. Plant numbers of microgreens per cm^2

The dry matter amount (%) was calculated by leaving the plant material in an oven at 65 ℃ until dry and proportioning the fresh weight and dry weight.

RESULTS AND DISCUSSION

The results of the research were analyzed using the SPSS 22 statistical program. The research results had ANOVA variance analysis and Tukey multiple comparison tests performed. The effects of different growth media on the agromorphological features of microgreens are given in Table 2.

Table 2. Effect of different growth media on agromorphological features of microgreens

Plant growth medium	Number of plants (/cm^2)	Stem length (cm)	Fresh weight (g)	Dry weight (g)
Cellulose fabric (CF)	7.60±0.84**a**	5.77±0.72**a**	28.16±7.52**a**	2.31±0.50**a**
White germination sponge (WGS)	7.43±1.58**a**	5.27±0.67**a**	17.54±1.93**ab**	1.42±0.37**ab**
Black germination sponge (BGS)	6.23±0.82**a**	3.13±0.31**b**	7.65±1.91**b**	0.99±0.56**b**

a, b,(↓) show statistical differences between plant types in the same column. Differences between rows shown with different letters are significant ($p<0.05$). Plant type, cellulose fabric, white germination sponge and black germination sponge media were compared between themselves.

When Table 2 is investigated, in terms of plant numbers per cm^2, the values were 7.60 for CF, 7.43 for WGS and 6.23 for BGS. When stem length is investigated, values were 5.77 cm for CF, 5.27 cm for WGS and 3.13 cm for BGS. When dry weight is investigated, values were 2.31 for CF, 1.42 for WGS and 0.99 for BGS. When fresh weight is examined, values were 28.16 g for CF, 17.54 g for WGS and 7.65 g for BGS.

Though there was no significant difference according to $p<0.05$, cellulose fabric may be recommended for microgreen cultivation in the confetti cabin in terms of the investigated criteria.

In spite of the short growing cycle, commercial cultivation of microgreens requires special care and selection of growth medium represents one of the most critical aspects of the production process. The growth medium comprises one of the main costs of production and plays an important role in determining the environmental sustainability of the production process, in addition to the yield and quality of the microgreens. According to Di Gioia et al. (2017), to ensure adequate water-holding capacity and ventilation, 55-70% of the total volume is recommended for microporous environments with 20-30% of the total volume recommended for macroporous environments. The environment (growth medium) should have pH of 5.5-6.5, electrical conductivity below 0.5 dS m^{-1} and should definitely be microbiologically safe. The cellulose fiber may be evaluated as a growth medium with these features and advantages.

According to Sukewijaya et al. (2025), selection of an appropriate growth medium has critical importance for the success of microgreen cultivation because it directly affects growth, yield and nutritional quality of the plants. Soil is a common growth environment supporting plant growth by providing a natural nutrient source and supporting microbial activity. However, the use of pure soil may sometimes limit the growth of some plants. If the moisture-holding and nutrient availability of organic matter in soil increases or is not appropriately managed, it may cause problems like compression and inadequate drainage. In the study, the negative effects mentioned by the authors were not encountered when using cellulose fabric, which is one of the growth media chosen in the research other than soil.

According to Di Gioia et al. (2017), textile materials may be used as renewable alternative substrates with low cost for microgreen production and ensure high yield and quality. The statements by these researchers are parallel to the findings of this research, showing that cellulose fabric may be used as a new production material. The use of cellulose fabric as production medium is directly correlated with the recommendation of Gruda (2012) about the use of growth media with organic content as an alternative to many growth media for use in plant production.

For microgreen cultivation, potential sources of microbial contamination are important elements that require attention. The use of cellulose fabric for production, in addition to clean seeds, is considered to be a growth medium for microgreens without any potential source of microbial contamination.

CONCLUSION

This study demonstrated that different growth media have distinct effects on the agromorphological characteristics of microgreens, with cellulose fabric generally yielding higher stem length, fresh weight, and dry weight values compared to white and black germination sponges. Although statistical differences were not significant at $p<0.05$, the overall performance of cellulose fabric indicates that it may serve as a suitable and sustainable growth medium for microgreen production. Considering its favorable physical properties, lack of microbial contamination risk, and alignment with recommendations in previous studies regarding alternative organic substrates, cellulose fabric presents a promising option for safe and efficient microgreen cultivation.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contribution

All authors contributed equally to the study design, data collection, analysis, and manuscript preparation.

Funding

This study was supported by TÜBİTAK 2209-A University Student Research Projects Support Program (Project No:1919B012319048). We are grateful to TÜBİTAK for their support and Tekirdağ Namık Kemal University Technical Sciences Vocational School Plant and Animal Production Department for their contributions to all stages of the study.

REFERENCES

Abad, M., Noguera, P., & Burés, S. (2001). National inventory of organic wastes for use as growing media for ornamental potted plant production: Case study in Spain. Bioresource Technology, 77(2), 197–200. https://doi.org/10.1016/S0960-8524(00)00152-8

Choi, M. K., Chang, M. S., Eom, S. H., Min, K. S., & Kang, M. H. (2015). Physicochemical Composition Of Buckwheat Microgreens Grown Under Different Light Conditions. Journal of the Korean Society of Food Science and Nutrition, 44(5), 709–715. https://doi.org/10.3746/jkfn.2015.44.5.709

Çiçek N., Yücedağ C. (2021). Usage of hazelnut husk as growing media in scarlet sage (Salvia splendens). Artvin Coruh University, Journal of Forestry Faculty. 22(2): 202-208. ISSN:2146-1880, e-ISSN: 2146-698X.

Düzgüneş, O., Kesici, T., Kavuncu, O., & Gürbüz, F. (1987). Araştırma ve Deneme Metodları. Ankara Üniversitesi, Ziraat Fakültesi Yayınları.

Di Gioia, F., & Santamaria, P. (2015a). Microgreens, agrobiodiversity and food security, in Microgreens, ed. by Di Gioia F. and Santamaria P. Eco-logica, Bari, pp. 7-23.

Di Gioia F., Leoni B., Santamaria P. (2015b). The selection of the species to grow, in Microgreens, ed. by Di Gioia F. and Santamaria P. Eco-logica, Bari, pp. 25-40.

Di Gioia F., Mininni C., Santamaria P. (2015c). How to grow microgreens, in Microgreens, ed. by Di Gioia F and Santamaria P. Eco-logica, Bari, pp. 51-79.

Di Gioia, F., De Bellis, P., Mininni, C., Santamaria, P., & Serio, F. (2017). Physicochemical, agronomical and microbiological evaluation of alternative growing media for the production of rapini (Brassica rapa L.) microgreens. Journal of the Science of Food and Agriculture, 97(4), 1212–1219. https://doi.org/10.1002/jsfa.7852

Gruda, N. (2012). Current and future perspective of growing media in Europe. Acta Horticulturae, 960, 37–43. https://doi.org/10.17660/ActaHortic.2012.960.3

Muchjajib, U., Muchjajib, S., Suknikom, S. and Butsai, J. (2015). Evaluation of organic media alternatives for the production of microgreens in Thailand. Acta Hortic. 1102, 157-162, https://doi.org/10.17660/ActaHortic.2015.1102.19

Murphy, C. J., Llort, K. F., & Pill, W. G. (2010). Factors affecting the growth of microgreen table beet. International Journal of Vegetable Science, 16(3), 253–266. https://doi.org/10.1080/19315261003648241

Roe, N. E. (2006). Growing microgreens: maybe the ultimate specialty crop! Proceedings of the Florida State Horticultural Society, 119, 289–290.

Sukewijaya, I. M., Dwiyani, R., & Bimantara, P. O. (2025). Optimization of Growing Media to Support Microgreens Growth and Nutritional Profile. Agro Bali, 8(1), 102–113. https://doi.org/10.37637/ab.v8i1.2249

Treadwell D.D., Hochmuth R., Landrum L., Laughlin W. 2010. Microgreens: A New Specialty Crop. IFAS Extension HS1164. University of Florida, Gainesville, FL.

Xiao, Z., Lester, G. E., Luo, Y., & Wang, Q. (2012). Assessment of vitamin and carotenoid concentrations of emerging food products: Edible microgreens. Journal of Agricultural and Food Chemistry, 60(31), 7644–7651. https://doi.org/10.1021/jf300459b

Xiao, Z., Luo, Y., Lester, G. E., Kou, L., Yang, T., & Wang, Q. (2014a). Postharvest quality and shelf life of radish microgreens as impacted by storage temperature, packaging film, and chlorine wash treatment. Lwt, 55(2), 551–558. https://doi.org/10.1016/j.lwt.2013.09.009

Xiao, Z., Nou, X., Luo, Y., & Wang, Q. (2014b). Comparison of the growth of Escherichia coli O157: H7 and O104: H4 during sprouting and microgreen production from contaminated radish seeds. Food Microbiology, 44, 60–63. https://doi.org/10.1016/j.fm.2014.05.015

Xiao, Z., Bauchan, G., Nichols-Russell, L., Luo, Y., Wang, Q., & Nou, X. (2015). Proliferation of Escherichia coli O157:H7 in soil-substitute and hydroponic microgreen production systems. Journal of Food Protection, 78(10), 1785–1790. https://doi.org/10.4315/0362-028X.JFP-15-063