AGROTECH–FOOD SCIENCE, TECHNOLOGY AND ENVIRONMENT VOL. 1 NO. 1 (2022) P.17-24


**AGROTECH**

**ISSN:** 2773-4870 **eISSN:** 2821-3106
DOI: https://doi.org/10.53797/agrotech.v1i1.3.2022

# The Effect of Different Growing Media on Physical Morphology of Rockmelon (*Cucumis Melo* Linn cv. Glamour) Seedling

**Ab Rauf, Muhammad Nasrul Hazzeem & Shahruddin, Shafeeqa***

Department of Agricultural Science, Faculty Technical and Vocational, Universiti Pendidikan Sultan Idris, 35900 Tanjung Malim, Perak, MALAYSIA

*Corresponding author: shafeeqa@ftv.upsi.edu.my

Received 8 December 2021; Accepted 19 December 2021; Available online 06 January 2022

**Abstract:** Rockmelon (*Cucumis melo* L.) belongs to the Cucurbitaceae family, which can adapt to various soil and climate areas, especially in Malaysia. The production of rockmelon in Malaysia has highly declined, and for this reason, farmers have opted to use the concept of soilless cultivation due to it benefits accrued from soilless media such as cocopeat, perlite, and burnt rice husk. The study was carried out to determine the effect of different growing media on the physical morphology of rockmelon seedlings. This experiment was set up using RCBD arrangements with four replications. Different growing media used were: (i) 100% Black Soil (BS), (ii) 75% cocopeat + 15% burnt rice husk + 10% perlite (M1) and (iii) 75% cocopeat + 20% burnt rice husk + 5% perlite (M2). The parameters measured were plant height, number of leaves and total leaves area, and stem girth. The data were collected within two weeks after transplanting. The parameters measured were subjected to ANOVA and LSD was applied to compare means. In this study, rockmelon seedlings treated on BS showed significantly ($P$<0.001) the highest plant height, number of leaves per plant, and total leaves area and stem girth. Seedlings on soilless M1, however, grew in slightly good conditions, as it showed the insignificantly higher values on morphological parameters measured. Thus, BS is still suitable for better use of media for 15 days old rockmelon seedlings (after transplanting). It gives the optimum conditions for adapting seedlings to the new exposure environment.

**Keywords:** Growing media, black soil, perlite, burnt rice husk, cocopeat

## 1. Introduction

Rockmelon or its scientific name *Cucumis melo* L. from the Cucurbitaceae family has become one of the most important plants in many countries around the world. Most of the early crops are grown because of their nutrients and they are also easy to care for and can adapt to various soil and climate areas. According to Villanueva et al. (2004), the demand for juicy fruits such as watermelon, honeydew, and rockmelon is very high in summer because it is very refreshing in addition to their sweet taste and a pleasant aroma. In Malaysia, they were initially associated with the growing of rockmelon due to the favorable climatic conditions for its growth. Farmers in Malaysia prefer to plant rockmelon using the seeds of the variety 'Glamour' which is also known as 'Golden Langkawi'. This is because of its sweet taste, bright skin color, popular, as well as its adaptability to live in an equatorial climate. Rockmelon is rich in bioactive compounds such as phenolics, flavonoids, and vitamins as well as carbohydrates and minerals, especially potassium. Besides, it is also low in fat and calories with large amounts of dietary fiber (Shafeek et al., 2015).

The most widely used method of cultivating rock melon is fertigation. According to Singandhupe et al. (2003), there are plenty of fertigation systems developed commercially and globally, which generally use the pH and electrical conductivity (EC) sensors to determine the correct ratio of water and the nutrient solution. Plants will get enough nutrients through irrigation provided in water drops and a mixture of fertilizer A and fertilizer B. In contrast, to cultivating watermelon, which is left searching for nutrients on the ground, rockmelon will be planted vertically wrapped around raffia rope or wire. Vertical planting will allow farmers to get maximum yield even if the planting is done in a limited growing area. Fertigation commonly uses a soilless planting medium such as cocopeat, perlite, burnt rice husk, etc.

The soil media used for growing plants in Malaysia seem to be less efficient. They lack the necessary nutrients, have uneven water drainage, low salinity levels and they encroach with pests that compete for nutrients with the rockmelon. These problems have led to the opportunity of using soilless media in rockmelon planting. The study is being carried out to gain an understanding of the potential use of the other growing media (e.g., soilless) in the early growth

**Corresponding author: shafeeqa@ftv.upsi.edu.my*

stages of rockmelon in comparison with the soil media. Growing media can be classified as any solid material other than soil, whether only its elements can be mixed with other materials, which can provide better results on plant growth, better than cultivation using soil either in one aspect or variety. Hence, this experiment aims to evaluate the effects of different growing media on the physical morphology of rockmelon seedlings.

## 2. Literature Review

### 2.1 Introduction to Rockmelon

Rockmelon is also known as cantaloupe, muskmelon, netted melon, Persian melon, or melon. The physical attributes of rockmelon are to be similar to honeydew or milk melon, and it is also known as one form of fragrant watermelon, but the netted outer surface of the skin, golden flesh, and orange flesh distinguish rockmelon from other watermelons, as well as a "musky" aroma.

### 2.2 Nutrient Requirement for Rockmelon

Nitrogen is a very important nutrient for the growth and development of rockmelon plants. The right amount and timing of nitrogen supply are also important for plant growth. However, too much nitrogen during flowering can inhibit rock melon flowering, and fruit production, and rockmelon yield. The form of nitrogen supplied to the crop is very important to maintain a good balance between the form of ammonium and nitrate to maintain rapid growth and good crop productivity. Potassium and nitrogen are also important to the growth of rockmelon, and this is because they can increase leaf growth and maximize yield potential. Rockmelon has a relatively high potassium requirement compared to nitrogen throughout its life. According to Kanai et al. (2007), farmers need to ensure that the supply of nitrogen is not limited before flowering, and during growth or it will affect the products that will be limited. However, many factors in terms of crops, soil, and environment often limit the intake of K from the soil in sufficient amounts to meet the needs of the fruit during development to optimize the quality attributes of the fruit.

### 2.3 Suitability of Media for Rockmelon Planting

Rockmelons do well almost in all temperatures of the world due to their good adaptability nature. They grow well in sandy, well-aerated, well-watered soil that is free from weeds. Fertilization is key in improving the yields of the rockmelon (Elmahdi et al., 2015). In soilless media, fertigation is used to regulate nutrient absorption and irrigation. Before planting, the soil should be turned appropriately and given two weeks to allow the residual from the previous crops to decompose. The soil pH should be maintained at a range of 6.0 to 6.5. The fertilizers used are mostly phosphorus and potassium. Rockmelons do well in sandy soils. However, the soils have a low water-holding capacity, making it necessary to irrigate when the rain is insufficient (Elmahdi et al., 2015). Lack of enough water delays the maturity of the melons and affects the output in the long run. Pests and disease control are also essential in ensuring the plant yields are not affected. Weed control measures should be implemented to ensure the melons do not compete for nutrients with the weeds.

### 2.4 Significant of Soil and Soilless Media for Crop

Soil mediums are composed of what we view as dirt. They contain structural and aeration elements. Soil is made unique by the humus it contains. Humus is referred to as decomposed organic matter that is rich in nutrients (Sankhalkar et al., 2019). A rich soil-based medium contains all the nutrients a plant requires in its lifecycle. The plants draw food from the soil instead of the farmer supplying them food through fertilizers. Soil-grown plants tend to yield slightly lesser output when compared to other media, but the plants express their genetic traits and have a better overall taste. Soilless media looks just like soil, but the difference is that the mix is purely structural and has no nutritional components (Sankhalkar et al., 2019). Some of the soilless mediums use peat moss to create a base for the structure of roots. They are amended with things like a volcanic rock to increase aeration. Soilless medium gives the farmer full control over the plant as they decide on what nutrients to supply, resulting in high yields.

### 2.5 Soilless Media

#### 2.5.1 Cocopeat

It is extracted from coconut husk in fiber as an agricultural by-product. Cocopeat is made into the potting mix, which is done carefully to maintain the porosity and the water retention is maximum. Cocopeat has adequate physical and chemical making it a suitable medium for growing plants. Cocopeat has a pH value of 6, which is optimum for most crops (Putra & Yuliando, 2015). However, cocopeat has a high salinity level, yet its mixtures are environmentally friendly. The chemical components, water retention capabilities, proper pH, and other chemical characteristics make cocopeat an essential medium for the crop as it guarantees high yields from the production.

### 2.5.2 Perlite

Perlite is harder, white in color, and made of mined volcanic rock. It is combined with other soilless media to produce high yields in crop production. The volcanic rock expands under rapid heating and retains lightweight aggregation, low bulk density, and is chemically inert in many environments. The material has a closed-cell structure making water only adhere to its surface without absorbing it, making perlite well-drained. Perlite has decent porosity, making it have good aeration (Putra & Yuliando, 2015). It has good moisture retention capabilities, which is an essential requirement for crops, especially during germination. Perlite possesses good drainage as the water it keeps is released slowly at low tension. Perlite is mainly used in nursery production and in greenhouses to produce high yields in crop production.

### 2.5.3 Burn Rice Husk

Burnt rice husk, also known as Charcoal Rice Hull, is filled with silica and potassium and also can be mixed with soil to provide more moisture and nutrient retention. In addition, it also absorbs odors and keeps the root system clean and tidy, and contributes nutrients to plants. It has a high potential to act as substitute manure as it can preserve the carbon stability in the soil. Biochar can retain nitrogen from being leached. This could be attributed to the high availability of carbon. The presence of charcoal makes it have high fertility (Asaduzzaman et al., 2015). The burnt rice husk is enriched with nutrients, enhanced bulk density, proper soil pH that contribute to high crop production. Biochar incorporation as a soil amendment is favorable in soil strength, escalating soil water content and porosity. The rice husk is considered as waste, but when burnt and introduced in the soil, they help increase soil fertility when used with charcoal.

## 2.6 Effects of Different Soilless Media Used in Crop

The quality of crops grown in soilless media is perceived to be better than the crops grown in soil. The growing environment is managed by controlling the weather factors and the composition of nutrients used. However, it is important to determine the appropriate growing media and the substrates used. A study conducted by Inden & Torres (2004) has found that the tomatoes propagated in different substrates, produced the highest yield and many fruits. These are suggested to be related to the use of soilless media perlite mixed with burnt rice husk while the amount highest of total soluble solids related to coco peat substrate. This shows that the different types of media used have an impact on crop growth and affect the yield in a planting project. This proves what other researchers say that the media's good physical and chemical properties so well suited to the type of crop allow farmers to manipulate destructive and infertile soil conditions to enhance crop growth on their farms (Cantliffe et al., 2007). The different effects of substrates on the development of crops, yields, and quality of watermelons grown in soilless culture were studied by Yetisir et al. (2006) previously. The research also shows that the usage of perlite as a soilless media in the cultivation of fruits such as watermelon gives a very good effect due to its ability to have the highest water and plant nutrient holding capacity. Furthermore, it also has increased aeration capabilities, strong capillaries, and low thermal conductivity and provides support following the crop's needs. The use of soilless media has helped increase crop production as most media has unique characteristics (Kumari et al., 2018). The media don't have pests which reduces the costs of eradicating them. They have a low density which makes it easier to transport them; they have high porosity, uniform texture, low content of soluble salts, and their pH levels can be adjusted to suit the crop production requirement.

# 3. Methodology

## 3.1 Study Site and Materials

An experiment was conducted under a netted rain shelter in Tanjong Malim, Perak. This study was started from May until June 2021. The Glamour seed variety of rockmelon was used in this study.

## 3.2 Seed Preparation and Transplanting

The certified seeds of rockmelon (Glamour variety) used in this study were obtained from a supplier of Nine Top Nursery in Rawang, Selangor. Rockmelon seeds were soaked in water for 30 minutes to break the seeds dormancy. Seeds of rockmelon germinate were sown into germination trays filled with peat moss (three-quarter filled per hole). Seeds must be placed in the center and vertically with a pointy side facing downward. Watering of seeds was done twice a day to maintain the peat moss moisture using the spraying bottle. The germinating tray was placed under a rain shelter. After 14 days, seedlings were transferred into 36 polybags (12 cm x 8 cm).

## 3.3 Media Treatments

Three different media treatments were used in this experiment. Cocopeat, burn rice husk, and perlite were bought from Bunga Ong Nursery from Banting, Selangor. Each treatment has a different media composition listed as below:

- (BS): 100% Black Soil (Topsoil)
- (M1): 75% cocopeat + 15% burnt rice husk + 10% perlite
- (M2): 75% cocopeat + 20% burnt rice husk + 5% perlite

## 3.4 Data Collections and Analysis

### 3.4.1 Vegetative Growth

The variables for vegetative growth were taken at the interval of three days throughout the seedling growing phases in two weeks. Vegetative growth variables included plant height, number of leaves per plant, leaf area, and stem girth.

a) Plant height was measured from the base to the tip of the highest leaf using a measuring tape.
b) Number of leaves was counted starting from a day after planting until day 15.
c) Leaf area was measured from the tips of the leaf to the end part (length) and the width of the leaf. The measurement was calculated using the formula:

*Total of Leaf Area = tips of the leaf to the end part (length) x width of the leaf* (1)

d) Stem girth was measured from the neck base node using a measuring tape.

## 3.5 Experimental Design and Statistical Analysis

This experiment was carried out in a Randomized Complete Block Design (RCBD). There were three treatments with different soilless media (BS, M1, and M2). Four replicates for each treatment and a total of 36 polybags were used in this study. The collected data was analyzed with a One-way Analysis of Variance (ANOVA) using the Statistical Analysis Software (SAS 9.4). The least significant difference (LSD) test at 0.05 was used to compare between means when ANOVA showed significant treatment effects.

## 4. Result and Discussion

## 4.1 Effect of Different Growing Media on Growth Morphology of Rockmelon Seedlings

Throughout the 15 days of the experimental period, data for vegetative growth were collected and recorded every three days after transplanting the rockmelon seedlings on three different growing media. In this study, the morphological parameters of rockmelon seedlings measured; plant height, number of leaves, total leaf area, and stem girth were highly significant ($P \leq 0.001$) affected by the different growing media after 15 days of the experimental period (Table 1). Besides, there were no significant differences between the three blocks toward the physical morphology of rockmelon seedlings.

**Table 1: Mean square error from ANOVA for the physical morphology of rockmelon seedling at 15 DAT**

| Source of variation | df | Height | Leaf Count | Leaf Area | Girth |
|---|---|---|---|---|---|
| **Media** | 2 | $367.76^{**}$ | $4.0^{**}$ | $12349.61^{**}$ | $0.112^{**}$ |
| **Block** | 2 | $5.27^{ns}$ | $0.0^{ns}$ | $1.59^{ns}$ | $0.014^{ns}$ |
| **Error** | 31 | 1.92 | 0.0 | 80.57 | 0.007 |
| **C.V** | | 5.74 | - | 10.52 | 5.69 |

Note: $^{**}$, Highly significant at $P<0.001$; $^{*}$, significant at $P<0.05$; ns, not significant; C.V = coefficient of variation

Rockmelon seedlings treated with BS as media show significantly higher means of all physical morphology variables measured during this study, as compared to other media (Table 2). The results indicate that using BS as media displayed better performance on the physical morphology of rockmelon seedlings for the first two weeks after transplanting.

**Table 2: Effect of different growing media on growth morphology of rockmelon seedlings at 15 days after transplanting**

| Treatment (Media) | Height (cm) | Leaf Count | Leaf Area ($cm^2$) | Girth (cm) |
|---|---|---|---|---|
| **BS** | 30.50[a] | 7.00[a] | 122.26[a] | 1.62[a] |
| **M1** | 21.53[b] | 6.00[b] | 68.96[b] | 1.46[b] |
| **M2** | 20.39[b] | 6.00[b] | 64.68[b] | 1.44[b] |
| **LSD** | 1.15 | 0.00 | 7.47 | 0.07 |

Note: Different superscripts ([a,b]) indicate significant differences among treatments. The value is expressed as mean.

Plant heights were measured at 3, 6, 9, 12, and 15 days after transplanting and the results are presented in Fig. 1. Rockmelon seedlings on BS media showed a significantly higher plant height than the ones on M1, followed by M2 throughout the growth stages. Seedlings on BS started to show a wide gap of plant height in between 6 to 9 of their growing days (66.3% differences). On the other hand, seedlings on M1 and M2 did not show any differences in their plant height from 3 until 15 days after transplanting (DAT). The pattern however shows a wide gap of plant height between 12 to 15 DAT for both treatments with 22.7% differences.

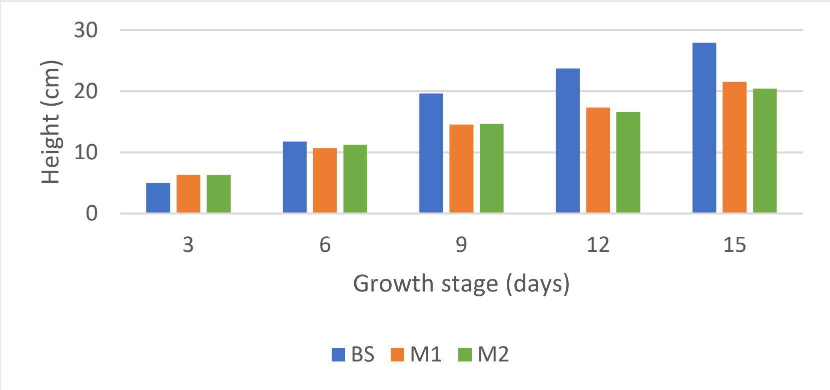


**Fig. 1: The height (cm) and growth stage (days) of rockmelon seedlings for 15 DAT**

The number of leaves (NOL) of rockmelon seedlings was measured for 15 DAT and the results are in Fig. 2. BS, M1, and M2 share the same mean NOL starting from 3 until 9 DAT. NOL for all treatments significantly increased steadily from 3 to 5 leaves 5 to 9 DAT. NOL for seedlings treated on M1 and M2 showed a stagnant pattern and increased to 6 leaves 12 DAT. On the contrary, seedlings treated on BS significantly increased for the NOL (6-7 leaves) starting from 12 to 15 DAT than the soilless media.

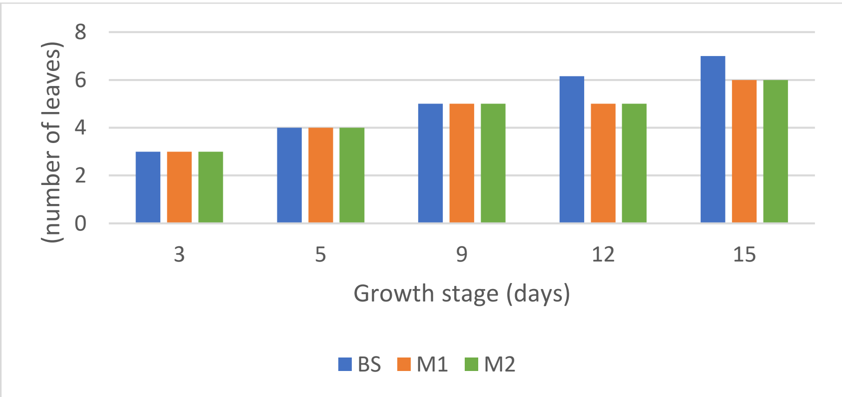


**Fig. 2: Number of Leaves and growth stage (days) of rockmelon seedlings for 15 DAT**

Seedlings treated on BS show a wide increment of leaf area starting from 6 DAT (by 10.8%) than during 3 DAT. It further showed a gradual increment of leaf area with the increasing growth stages, before displaying the highest differences at 15 DAT (83.11% increments). Seedlings grown on soilless M1 and M2 also showed a similar pattern of leaf area, especially with the highest differences shown during 15 DAT (29.4% increments). The highest mean leaf area (122.63 $cm^2$) was obtained from rockmelon seedlings on BS and the lowest (64.49 $cm^2$) from plants on M2.

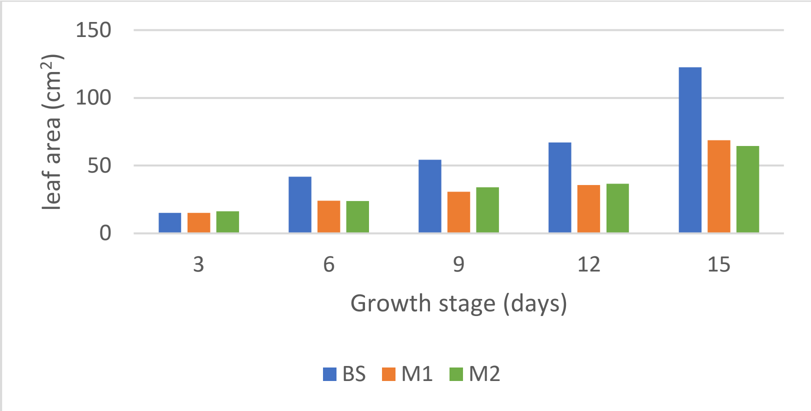


**Fig. 3: Leaf area ($cm^2$) and growth stage (days) of rockmelon seedlings for 15 DAT**

There were no significant differences in stem girth shown in all media treatments for 3 and 6 DAT (Fig. 4). Seedlings grown on BS showed an increased stem girth more than the other treatments, starting at 9 to 15 DAT (increased by 22% to 80%). On the other hand, seedlings grown on M1 and M2, which were not significantly different from each other, showed lower stem girth, about 60% to 62 % than BS, starting from 9 to 15 DAT. The highest mean of stem girth from seedling grown on BS (1.62 cm) was recorded followed by those grown on M1 (1.46 cm) and the lowest (1.44cm) from those grown on M2.

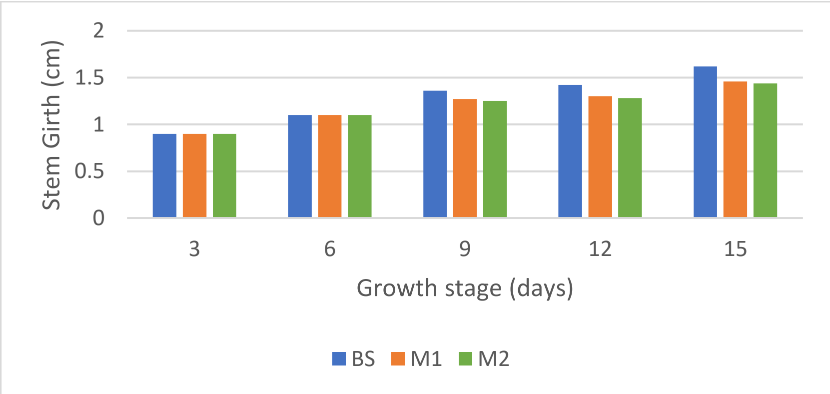


**Fig. 4: The stem girth (cm) and growth stage (days) of rockmelon seedlings for 15 DAT**

Table 3 shows Pearson's correlations among the seedling variables measured (plant height, number of leaves, leaf area and stem girth). The results showed highly positive correlations of plant height with number of leaves ($r = 0.95^{**}$), leaf area ($r = 0.93^{**}$), and stem girth ($r = 0.62^{**}$); number of leaves with leaf area ($r = 0.95^{**}$) and stem girth ($r = 0.62^{**}$); and leaf area with stem girth ($r = 0.59^{**}$).

**Table 3: Pearson's correlation table**

| Correlations | Height | Number of Leaves | Leaf Area | Stem Girth |
|---|---|---|---|---|
| **Height** | - | | | |
| **Number of Leaves** | $0.95^{**}$ | - | | |
| **Leaf Area** | $0.93^{**}$ | $0.95^{**}$ | - | |
| **Stem Girth** | $0.62^{**}$ | $0.68^{**}$ | $0.59^{**}$ | - |

Notes: $^{**}$, significant at $P \leq 0.001$

The parallel growth of variables such as plant height, number of leaves, and leaf area, displayed through their highly positive correlations (r >0.90). Besides, the increased plant height of seedlings in BS compared to M1 and M2 was possibly due to better availability of soil moisture, optimum soil temperature, and suitable pH provided by the medium (Shinde et al., 1999). Balasubramanian et al. (2007) found that the seedling growth rate was directly proportional to the plant leaf area. Among the variables measured in this study, all the treatments showed the highest growth increment on leaf area, especially during 15 DAT. This indicates the quite similar adaptability shown for the soil and soilless media treatments, but with different growth rates. The lower values of correlation for stem girth (r <0.70) further indicated the roles of external environments might affect their growth. However, seedlings treated on BS might have the advantage based on studies made by Crombi & Tippett (1990) and Hamdan & Shafar (2017). They found that the presence of soil organic matter increases soil water holding capacities and therefore increases the stem size of plants.

During the present study, seedlings treated on BS displayed significantly better physical morphology than seedlings in soilless (M1 and M2) treatments. Among all, this might be due to the high organic matter in the black soil, which is also rich in nutrients that contribute to better plant growth (Sankhalkar et al., 2019). On the other hand, with the large gap of differences between BS and the soilless media, seedlings on M1 however, showed significantly higher values of plant height, leaf area, and stem girth variables, than seedlings on M2. With the nutrients mostly concentrated in the composition of burnt rice husk, the higher perlite percentage (10%) contained in M1 might give some slight advantages compared to M2. The character of perlite as good moisture retention might help the developing seedling's root to concentrate their growth in some reservoir areas in the media, which further increases the water and nutrients transportation within the seedling.

## 5. Conclusion

From the assessment of rockmelon seedling growth variables at the early stages of vegetative with different media, it can be concluded that there is no significant effect of using different soilless media. Black soil is suitable for better media use for the growth within 15 days old rockmelon seedlings (after transplanting). It gives the optimum conditions needed in adapting seedlings to the new exposure environment. Despite the disadvantages of natural black soil conditions, the fewer nutrients available in soilless media preceding their needs to grow well especially within 15 days after transplanting.

## Acknowledgement

The authors would like to express their gratitude to the Universiti Pendidikan Sultan Idris,Malaysia for their support in providing both facilities and financial assistance for this research.

## Conflict of Interest

The authors declare no conflicts of interest.

## References

Asaduzzaman, K., Khandaker, M. U., Amin, Y. M., & Mahat, R. (2015). Uptake and distribution of natural radioactivity in rice from soil in north and west part of peninsular Malaysia for the estimation of ingestion dose to man. *Annals of Nuclear Energy*, *76*, 85-93.

Balasubramanian, G., Udayasoorian, C., & Prabu, P. C. (2007). Effects of short-term exposure of simulated acid rain on the growth of *Acacia nilotica*. *Journal of Tropical Forest Science*, *19*, 198-206.

Cantliffe, D. J., Castellanos, J. Z., & Paranjpe, A. V. (2007). Yield and quality of greenhouse-grown strawberries as affected by nitrogen level in coco coir and pine bark media. *Proceedings of Florida State Horticultural Society*, *120*, 157-161.

Crombi, D. S., & Tippett, J. T. (1990). A comparison of water relations, visual symptoms, and changes in stem girth for evaluating impact of *Phytophthora cinnamomi* dieback on *Eucalyptus marginata*. *Canadian Journal of Forest Research, 20*(2), 233-240.

Elmahdi, S., Kadir, J., Mohamed, M. T. M., Vadamalai, G., & Akter, S. (2015). Isolation, screening and characterization of effective microbes with potential for biological control of fusarium wilt of rockmelon. *World Journal of Agricultural Research*, *3*(1), 11-16.

Inden, H., & Torres, A. (2004). Comparison of four substrates on the growth and quality of tomatoes. *Acta Horticultureae*, 644, 205-210. http://www.doi.org10.17660/Acta Hortic.2004.644.27.

Hamdan, M. N., & Shafar, J. M. (2017). Effect of water irrigation techniques on growth and yield of rock melon (*Cucumis melo* Linn cv. Glamour). *Advances in Plant Science and Technology*, *80*.

Kanai, S., Ohkura, K., Adu-Gyamfi, J. J., Mohapatra, P. K., Nguyen, N. T., Saneoka, H., & Fujita, K. (2007). Depression of sink activity precedes the inhibition of biomass production in tomato plants subjected to potassium deficiency stress. *Journal of Experimental Botany, 58*, 2917–2928.

Kumari, S., Pradhan, P., Yadav, R., & Kumar, S. (2018). Hydroponic techniques: A soilless cultivation in agriculture. *Journal of Pharmacognosy and Phytochemistry*, *1*, 1886-1891.

Putra, P. A., & Yuliando, H. (2015). Soilless culture system to support water use efficiency and product quality: A review. *Agriculture and Agricultural Science Procedia*, *3*, 283-288.

Sankhalkar, S., Komarpant, R., Dessai, T. R., Simoes, J., & Sharma, S. (2019). Effects of soil and soil-less culture on morphology, physiology and biochemical studies of vegetable plants. *Current Agriculture Research Journal, 7*(2), 181.

Shafeek, M. R, Aisha, H. A., Asmaa, R. M, Magda, M. H., & Fatma, A. R. (2015). Improving growth and productivity of Garlic plant (*Allium sativum* L) as affected by the addition of organic manure and humic acid levels in sandy soil condition. *International Journal of Current Microbiology and Applied Sciences*, *4*(9), 644-656.

Singandhupe, R. B., Rao, G. G. S. N., Patil, N. G., & Brahmanand, P. S. (2003). Fertigation studies and irrigation scheduling in drip irrigation system in tomato crop (*Lycopersicon esculentum* L.). *European Journal of Agronomy*, *19*(2), 327-340.

Shinde, U. R., Firake, N. N., Dhotery, R. S., & Banker, M. C. (1999). Effect of micro irrigation systems and mulches on microclimate factors and development of crop coefficient models for summer chilli. *Journal of Maharashtra Agricultural Universities*, *24*(1), 72-75.8

Villanueva, M. J., Tenorio, M. D., Esteban. M. A., & Mendoza, M. C. (2004). Compositional changes during ripening of two cultivars of muskmelon fruits. *Food Chemistry, 87*, 179-185.

Yetisir, H., Caliskan, M. E., Soylu, S., & Sakar, M. (2006). Some physiological and growth responses of watermelon [*Citrullus lanatus* (Thunb.) Matsum. and Nakai] grafted onto *Lagenaria siceraria* to flooding. *Environmental and Experimental Botany*, *58*(1-3), 1-8.