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Morpho-Physiological Responses of *Cucumis sativus* L. Seedlings to Various Culture Media

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ABSTRACT

Various culture media contain a variety of materials that affect plant growth and development. Finding the best media culture among the various materials is thus critical to plant productivity. This study was conducted based on a completely randomized design using eight treatments and three replications. The treatments included the ratios 30:10:60 of perlite-vermicompost-coco peat, peat moss-vermicompost-palm peat, coco peat-vermicompost-palm peat, perlite-vermicompost-palm peat, and the ratios 30:70 of peat moss-palm peat, coco peat-palm peat, perlite-palm peat, and vermicompost-palm peat. Cucumber seeds were planted in pots containing these culture media under greenhouse conditions. After the four-leaf stage, the morpho-physiological responses of the seedlings were evaluated. According to the findings, when compared to perlite-vermicompost-coco peat medium, peat moss-vermicompost-palm peat increased shoot fresh weight by 5.5-fold, root fresh weight by 4.5-fold, root dry weight by 5.8-fold, shoot dry weight by 7-fold, stem diameter by 1.7-fold, shoot length by 2.3-fold, root length by 1.3-fold, and leaf area by 3.8-fold. However, compared to seedlings grown in peat moss-vermicompost-palm peat medium, the amount of auxin and reactive oxygen species decreased while total soluble sugars and peroxidase increased in perlite-vermicompost-coco peat medium. Our findings indicate that the composition of peat moss-vermicompost-palm peat can be used as a beneficial medium to improve quality of cucumber seedling under greenhouse conditions.

Keywords: Cucumber, Palm peat, Peat moss, Perlite-vermicompost-coco peat.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important vegetables in the world, with an annual production of around 91.3 million tons (Faostat, 2020). Iran ranked fourth in the world in cucumber production in 2020, with 1.2 million tons, after China, Turkey, and Russia (Faostat, 2021). A broad variety of soilless cultivation techniques for producing horticultural crops, particularly under greenhouse conditions, have been developed and commercialized in recent years. Plant development can be affected directly or indirectly by many components in various media. Therefore, selecting the best media among a variety of media is critical for plant production. Soilless growing technologies for cucumbers and many other vegetable crops provide benefits such as faster plant development, greater yield and quality (Ebrahimi *et al*., 2012). Water, medium components, and air are the three main characteristics of a culture medium responsible for producing optimal growth conditions for the roots as well as physical support for the plants (Ainiwaer *et al*., 2020; Farrokhi *et al*., 2021).

The components of mixed culture media are usually selected based on their physical

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properties to complement one another and provide the ideal conditions for plant growth. For example, vermicompost medium, which often lacks coarse particles necessary for proper aeration of the culture media, is combined with culture media such as perlite. Perlite is a common inorganic component used in various culture media. It is principally made of SiO_2, Al_2O_3, Na_2O, K_2O, and water. It has a low density, high porosity, low weight, poor cation exchange capacity, and a slightly acidic pH (5.5-7) (Członka *et al*., 2021). In comparison to coco peat and peat moss, adding perlite to culture media can increase their volume, reduce costs, and improve air movement (Ilahi *et al*., 2017). Peat moss, a typical component of culture medium, is created when plants partially decompose under anaerobic or semi-aerobic swamp conditions. It has a high water holding capacity and strong aeration, as well as a low apparent density, an acidic pH (about 0.5), and a high cation exchange capacity (Kamrani *et al*., 2014). Coco peat is a soilless culture medium created from crushed coconut shells following a number of operations such as desalination and drying. It has great physical qualities, such as a high capacity for fertilizer, water and aeration storage. This culture medium is reusable and may be used again and again (Lu *et al*., 2021). Vermicompost is the final product of an earthworm's digestive system. In terms of physical, chemical, and nutritional properties, it is a stable product that contains nutrients, enzymes, and hormones that can increase soil dynamics and nutrition Vermicompost can also enhance soil structure, reduce erosion, promote plant growth, and increase disease resistance (Singh and Singh, 2017). Date palms (*Phoenix dactylifera*) produce a huge quantity of waste throughout their development. However, the biological value of date palm waste has received little study. Palm waste has a high potential for use as a plant culture media (Mohammadi Ghehsareh, 2013). Using palm waste compost or palm peat (30 tons per hectare) reportedly caused a significant increase in the main properties of the soil such as organic matter and water retention capacity, while reducing electrical conductivity. Palm peat can be replaced with chemical fertilizers as an excellent organic fertilizer with acceptable results (Benabderrahim *et al*., 2018). Currently, peat moss is largely utilized in the greenhouse business, and the price of peat moss is always rising owing to mining problems and rising transportation expenses, which directly affect farmers' financial situations. Utilization of low-cost plant components in culture media can help farmers and investors cut production expenses.

The purpose of this research was to find a suitable combination of date palm compost (palm peat) with a variety of other materials in culture media for the development of cucumber seedlings under greenhouse conditions.

MATERIALS AND METHODS

Experimental Site and Plant Materials

This experiment was carried out in the fall of 2021 in the research greenhouse at the University of Jiroft, Iran, using a completely randomized design with eight treatments and three replications. The average day/night temperature was 30/25±2°C, the relative humidity was 85±5%, and the light intensity was around 10,000 lux. The treatments included eight culture media and three replications. The culture media included v:v:v ratios (30:10:60) of perlite-vermicompost-coco peat (p-vc-co), which lacked palm peat and was considered as the control group, peat moss-vermicompost-palm peat (pm-vc-pp), coco peat-vermicompost-palm peat (co-vc-pp), perlite-vermicompost-palm peat (p-vc-pp), and v:v ratios (30:70) of peat moss-palm peat (pm-pp), coco peat-palm peat (co-pp), perlite-palm peat (p-pp), and vermicompost-palm peat (vc-pp). Table 1 shows the chemical

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Table 1. Chemical parameters of the materials used in the culture media for cucumber cultivation.

Culture media	EC (mS m^{-1})	pH	N (%)	K (%)	P (%)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Zn (ppm)
Peat moss	0.75	6.73	0.11	1.26	0.86	0.20	0.16	0.30	0.07
Vermicompost	2.66	6.58	0.16	1.33	0.44	0.36	0.13	0.66	0.07
Palm peat	1.73	6.78	0.12	0.86	0.39	0.22	0.18	0.33	0.03
Coco peat	1.10	6.92	0.10	0.44	0.26	0.16	0.11	0.31	0.02
Perlite	0.16	7.70	0.06	1.11	0.06	0.10	0.04	0.03	0.01

parameters of the materials used in the culture media for cucumber cultivation.

Cucumber seeds were planted in the pots (10 cm high, 8 cm diameter). During seedling growth, all treatments received the same watering rate, temperature, humidity, light, pest control. The pots were filled with the culture media. Throughout the growth phase, the plants were fed weekly with the nutrient solution (half-strength Hoagland), and to prevent damage caused by white flies, the plants were placed inside insect-netted chambers. The seedlings were slowly removed from the pots after 30 days, when they had three fully expanded leaves. The roots were washed and shoots were separated from the roots.

Biometric Measurements

A digital scale (±0.001 g) was used to determine the fresh and dry weight of shoot and roots. A digital caliper was used to determine the stem diameter. Leaf area, number of leaves, root length, and stem length were all calculated using the Digimizer software.

Biochemical Measurement

The SPAD index was measured using a hand-held chlorophyll meter (SPAD-502 meter) one day before the experiment was concluded at 10 AM. The biochemical parameters were measured from fully expanded third leaves. Carotenoids, chlorophyll *a*, *b*, and total chlorophyll were measured using the Lichtenthaler and Buschmann (2001) method. Total sugar content was determined using the sulfuric acid method (Albalasmeh *et al*., 2013). The amount of ROS was measured using the acidic xylenol orange technique (Tirani and Haghjou, 2019), and the results were presented as µmol g^{-1} FW. The activities of Peroxidases (POX) in leaf tissue were determined using Resende *et al*. (2002) method.

Statistical Analysis

SAS software (9.4) was used to assess data variance and compare averages using Duncan's multiple range test after data normalization, and graphs were created using EXCEL software. To determination of correlation coefficients between the biochemical parameters was used Minitab 16 software (Table 4).

RESULTS AND DISCUSSION

Plant Growth Regulation

The soil media typically has many restrictions that limit seedling growth and survival. Gaseous exchange impediments, residual nitrate and pesticides, and excessive salt levels are among the restrictive factors. As a result, for seedling development, soilless media are commonly preferred (Mohammadi Ghahsareh and Kalbasi, 2012). It was discovered that soilless media is superior to soil culture for zinc absorption, plant development, and flowering (Mazaheri Trani *et al*., 2018). The use of various

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organic-inorganic media in soilless cultures allows seedlings to have a superior nutritional element composition, adequate gas exchange, and optimal water-holding capacity (Mohammadi Ghahsareh and Kalbasi, 2012). The biometric parameters of cucumber seedlings were significantly affected by soilless culture media (various combinations of palm peat, perlite, vermicompost, and coco peat) (Table 2). The shoots and roots of seedlings cultivated on pm-vc-pp and p-vc-co had the highest and lowest fresh weight, respectively (Table 2). When compared to p-vc-co, shoot fresh weight and root fresh weight increased by 5.5-fold and 4.5-fold, respectively. The shoot/root ratios of seedlings cultivated on pm-vc-pp and p-vc-pp, were the highest and lowest, respectively. There was no significant difference in shoot/root ratio between seedlings grown on p-vc-pp and p-vc-co. Our findings are consistent with the results of Mohammadi Ghehsareh *et al.* (2012), who reported that the fresh and dry weights of cucumber plants increased when grown in a palm peat medium rather than perlite. Furthermore, Alikhani and Mohammadi (2008) found that using vermicompost increased the dry weight of tomato plants. Other researchers found that adding vermicompost to the soil improved plant growth by increasing humic acid content, symbiotic microbes, and growth regulators (Ali *et al*., 2007). According to Dhen *et al*. (2018), lettuce biomass increased in culture medium containing 20 to 50% palm peat, while fresh and dry weights decreased in culture media containing 100% peat, which can be related to the water storage capacity and porosity of the culture media. According to our results (Table 2), plants grown in pm-vc-pp had the highest dry weight of the roots and shoots. The dry weight of roots and shoots increased

Table 2. Effect of culture media on biometric parameters of cucumber seedlings.[a]

Culture media	Shoot FW (g)	Root FW (g)	Shoot/ root	Shoot DW (g)	Root DW (g)
p-vc-co (30-10-60)	0.92[d]	0.50[d]	1.87[bc]	0.09[d]	0.02[f]
pm-vc-pp (30-10-60)	5.11[a]	2.22[a]	2.32[a]	0.53[a]	0.14[a]
co-vc-pp (30-10-60)	2.65[bc]	1.29[c]	2.08[ab]	0.23[bc]	0.07[de]
p-vc-pp (30-10-60)	3.11[b]	1.82[ab]	1.73[c]	0.28[b]	0.09[bc]
Pm-pp (30-70)	3.28[b]	1.79[b]	1.85[bc]	0.26[bc]	0.10[b]
co-pp (30-70)	2.23[c]	1.21[c]	1.86[bc]	0.22[b]	0.06[de]
p-pp (30-70)	2.65[bc]	1.44[bc]	1.85[bc]	0.23[bc]	0.08[cd]
vc-pp (30-70)	2.71[bc]	1.25[c]	2.18[a]	0.21[e]	0.06[d]
Culture media	Shoot length (cm)	Root length (cm)	Leaf area (cm^2)	Stem diameter (mm)	Leaf number
p-vc-co (30-10-60)	6.94[c]	14.96[c]	5.58[e]	2.64[d]	4.00[c]
pm-vc-pp (30-10-60)	16.13[a]	19.16[ab]	20.99[a]	4.45[a]	5.67[a]
co-vc-pp (30-10-60)	12.10[b]	16.46[bc]	11.74[bc]	3.97[ab]	5.00[ab]
p-vc-pp (30-10-60)	11.93[b]	18.83[ab]	14.38[b]	4.39[a]	5.00[ab]
Pm-pp (30-70)	11.93[b]	20.09[a]	10.41[cd]	4.01[ab]	4.33[bc]
co- pp (30-70)	12.35[b]	14.17[c]	8.23[de]	3.59[bc]	5.00[ab]
p- pp (30-70)	17.13[s]	14.17[c]	10.85[cd]	3.80[bc]	5.33[a]
vc-pp (30-70)	13.62[ab]	14.00[c]	13.15[bc]	3.36[e]	5.33[a]

[a] co: Coco peat; p: Perlite; pm: Peat moss; pp: Palm peat and vc: Vermicompost. Different letters in a column indicate significant differences at P≤ 0.05 among the culture media, based on Duncan's multiple range test. [ns] and ** indicate non-significance, and significant (P≤ 1%), respectively based on Duncan's multiple range test.

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by 5.8-fold and 7-fold, respectively, in pm-vc-pp when compared to p-vc-co medium. Our results confirmed previous findings by Shirani and Mohammadi Ghahsareh (2013), who reported that tomato root dry weight increased when grown in palm peat versus perlite media. Stem diameter was greatest in seedlings grown in pm-vc-pp and p-vc-pp media. Seedlings grown in p-vc-co medium had the smallest stem diameter, which was 1.7- fold smaller than seedlings grown in pm-vc-pp. Our results are consistent with those of Mohammadi Ghehsareh *et al*. (2011), who found that using palm peat instead of perlite as a culture media increased tomato stem diameter. The seedlings grown in pm-vc-pp had the greatest shoot length, root length, and leaf area, which increased by 2.3-, 1.28-, and 3.76-fold, respectively, compared to p-vc-co. Our results support previous findings by Mohammadi Ghahsareh (2013), who reported that palm peat increased the shoot length of cucumber plants when compared to rice hull mixed with soil. The maximum leaf number was observed in seedlings grown in pm-vc-pp medium, with 1.42-fold more leaves than p-vc-co. When the biometric parameters of greenhouse cucumber seedlings were evaluated (Table 2), it was discovered that the seedlings grown in p-vc-co medium, which lacked palm peat, had the lowest growth and quality compared to the other culture media. It can be inferred that palm peat improves the quality of greenhouse cucumber seedlings. The bulk of pm-vc-pp was composed of palm peat and peat moss (60 and 30%, respectively), which were replaced in p-vc-co medium with coco peat and perlite. Palm peat and peat moss appeared to have delivered more nutrients (N, K, P, Mn, Cu, Fe, and Zn) than coco peat and perlite, thereby increasing seedling growth (Table 1). Despite this, because of its high electrochemical conductivity, higher stability, and lower bulk density, perlite is widely used as a suitable culture media, especially for vegetable cultivations in greenhouses (Mohammadi Ghehsareh and Kalbasi, 2012). Because of its high pH and low nutritional content, perlite appear to be unsuitable for cucumber seedlings growth. On the other hand, palm peat (60%) in combination with 30% peat moss and 10% vermicompost has a beneficial effect on increasing the quality of greenhouse cucumber seedlings. While evaluating the development of most plants, Rahbarian *et al*. (2014) observed that among several culture media, palm peat were not significantly different with peat moss. As a result, this medium can replace peat moss.

Photosynthetic Pigments

Photosynthetic pigments in cucumber seedlings were significant ($P \leq 0.01$), affected by culture medium (Table 3). Seedlings grown in pm-pp had the highest SPAD index, as well as carotenoids and chlorophyll *a*, *b* and total chlorophyll. There was no significant difference between the SPAD index, carotenoid and chlorophyll *a*, *b*, total in the seedlings grown in pm-pp and pm-vc-pp. Also, the lowest value of the SPAD index belonged to the seedlings grown in p-vc-co medium, while the seedlings grown in co-pp medium had the lowest contents of carotenoids, and chlorophyll *a*, *b*, and total chlorophyll (Table 3). As a result, the use of p-vc-co (30-10-60) or pm-vc-pp (30-10-60) media showed that these media were a suitable combination that increased the amounts of photosynthetic pigments. Table 1 shows that the nitrogen content of pm-vc-pp components was higher than that of p-vc-co medium. Because nitrogen usually participates in the structure of chlorophyll, the decrease in photosynthetic pigments in p-vc-co medium could be due to nitrogen deficiency in this culture medium.

Also, under these experimental conditions, the possibility of a decrease in photosynthetic pigments cannot be ruled out, especially given the destruction of chloroplasts and photosynthetic apparatus, damage to Chl biosynthesis, interaction with ROS, and a higher increase in

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Table 3. Effect of culture media on photosynthesis pigments of cucumber seedlings. [a]

Culture media	SPAD	Chla (mg g^{-1} FW)	Chlb (mg g^{-1} FW)	Total Chl (mg g^{-1} FW)	Car (mg g^{-1} FW)
p-vc-co (30-10-60)	27.57^{c}	0.46^{cd}	0.13^{de}	0.65^{e}	0.19^{bc}
pm-vc-pp (30-10-60)	34.03^{ab}	0.73^{b}	0.21^{b}	0.98^{b}	0.24^{b}
co-vc-pp (30-10-60)	30.70^{bc}	0.49^{cd}	0.14^{cde}	0.67^{d}	0.21^{bc}
p-vc-pp (30-10-60)	32.07^{abc}	0.50^{cd}	0.12^{e}	0.62^{de}	0.22^{bc}
Pm-pp (30-70)	35.70^{a}	0.95^{a}	0.28^{a}	1.28^{a}	0.35^{a}
co-pp (30-70)	29.07^{c}	0.42^{d}	0.12^{e}	0.53^{e}	0.16^{c}
p-pp (30-70)	27.60^{c}	0.60^{bc}	0.18^{bc}	0.78^{c}	0.24^{b}
vc-pp (30-70)	31.73^{abc}	0.66^{b}	0.18^{bcd}	0.87^{c}	0.24^{b}

[a] Symbols are defined under Table 2.

Table 4. Pearson's correlation coefficient between the biochemical parameters.

	ROS	TSS	Peroxidase
TSS	0.328^{ns}		
Peroxidase	-0.482*	-0.468*	
Auxin	0.804**	0.330^{ns}	-0.294^{ns}

^{ns} *, and ** indicate non-significance and significance at P≤ 5% and 1%, respectively.

chlorophyllase activity (Michael and Krishnaswamy, 2014).

Oxidant and Antioxidant System Parameters

The existence of oxidative stress in various culture media is usually caused by an imbalance in generation and removal of ROS, including peroxides, hydroxyl singlet oxygen, radical, radical superoxide ($O_2^{\bullet-}$), and Hydrogen peroxide (H_2O_2) in the intracellular fluid (Sachdev *et al*. 2021; Nadarajah, 2020). The amount of ROS in the leaves of cucumber seedlings was significantly affected by the culture media (Table 4). There was a significant positive correlation between ROS and auxin (0.804**), while a significant negative correlation (-0.482*) between ROS and POX (data not shown).

While seedlings grown in p-vc-co medium grew the slowest when compared to other culture media (Table 2), accumulation of ROS in p-vc-co medium was expected to be higher than pm-vc-pp. It was significantly lower when compared to the seedlings grown in pm-vc-pp medium (Figure 1). In contrast to pm-vc-pp medium, the amount of peroxidase enzyme (Figure 2) increased in p-vc-co medium. It can be inferred that the reduction of ROS in p-vc-co medium occurred as a result of increased peroxidase activity, which acts as an antioxidant under nutritional stress conditions to overcome oxidative stress. Since the nutrients in p-vc-co medium are in lower concentrations that in pm-vc-pp, plant metabolism produce more ROS as a mean of producing more secondary messengers and participants in cell homeostasis. In addition, ROS production increased in reactions of photosynthesis and respiration in stressed plants. High levels of ROS eventually damaged metabolites such as lipids, proteins, and DNA, which led to their oxidation and finally culminated in cell death (Nadarajah, 2020; Sachdev *et al*., 2021). Plants are known to activate their defensive mechanisms both enzymatically (e.g. by POX, CAT, APX, and SOD) and non-enzymatic (via phenolic compound, anthocyanin, and carotenoids), thereby overcoming the effects of oxidative stress

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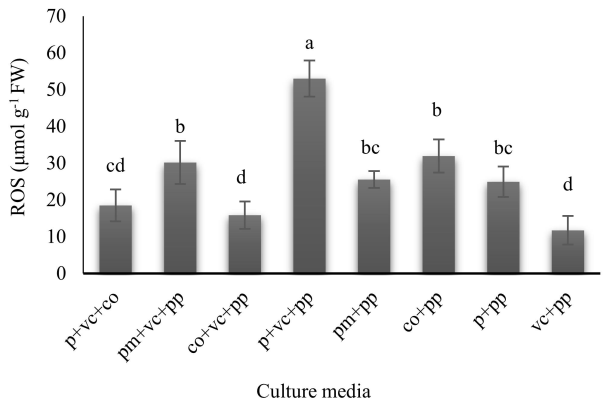

Figure 1. Effect of culture media on the amounts of ROS in cucumber seedlings (co: Coco peat; p: Perlite; pp: Palm peat; pm: Peat moss and vc: Vermicompost).

via ROS-scavenging molecules (Tirani and Haghjou, 2019).

Peroxidase enzyme was significantly affected by the culture media (data none shown). In contrast to ROS, the highest peroxidase accumulation was observed under vc-pp (Figure 2), and there was a significant and negative correlation (-0.482*) between peroxidase and ROS (data none shown). Since peroxidase is naturally found in the organelles of all plant cells, its activity increases in reaction to ROS production and decreases in response to ROS reduction. The guaiacol peroxidase enzyme, which is one of the important enzymes that destroy hydrogen peroxide (produced by photorespiration) in plants, is used as a crucial biological indicator in stress-related damage studies (Katsuhara *et al*., 2005). The enzyme phenylalanine ammonia-lyase is required for the phenylpropanoid pathway, which is one of the non-enzymatic defensive mechanisms in plant cells and one of the indicators that sensitively responds to environmental variations. Also, as biochemical indicators, their amounts increase for plant defense against stresses (Vogt, 2010).

Carbohydrates have a systemic effect on plant development. Culture medium had a significant effect on Total Soluble Sugars (TSS). The content of TSS increased insignificantly in seedlings grown in p-vc-co medium compared to pm-vc-pp, which had the highest vegetative growth (Figure 3). The amounts of phosphorus and nitrogen in perlite and coco peat, which made up a large portion of the p-vc-co medium, were very

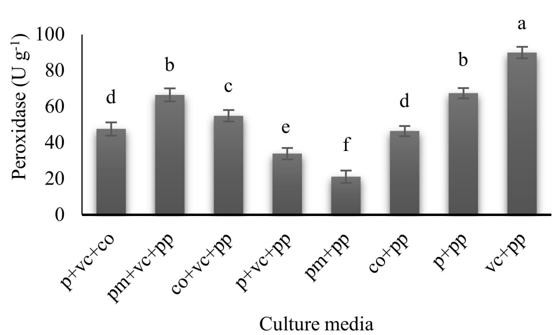

Figure 2. Effect of culture media on leaf peroxidase content of cucumber seedlings (Symbols are defined in Figure 1 and pr: Protein).

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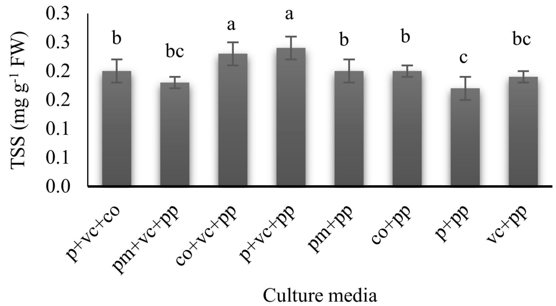

Figure 3. Effect of culture media on Total Soluble Sugars (TSS) in the leaves of cucumber seedlings. (Symbols are defined in Figure 1).

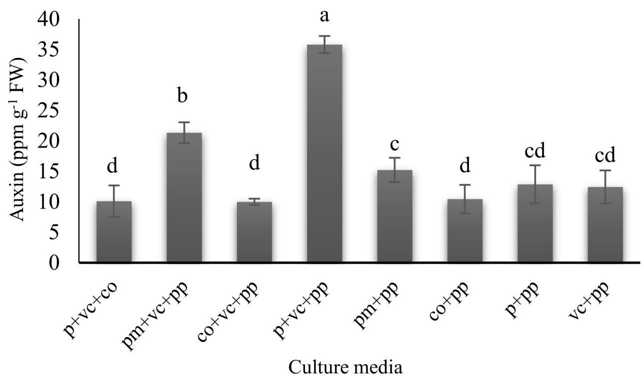

Figure 4. Effect of culture media on leaf auxin in cucumber seedlings (Symbols are defined in Figure 1).

low, according to the analysis of culture media components (Table 1). Therefore, more soluble sugars accumulated in these seedlings, compared to the effect under pm-vc-pp, possibly due to a phosphorus deficiency that decreased the ATP synthesis and disrupted sugars transfer to the vessels. This resulted in the accumulation of sugars in the leaf. Because the physiological response of roots to phosphorus deficiency can actualize as an impediment to biosynthesis and a blockage in the translocation of leaf carbohydrates, the amounts of sugars are largely affected by these effects (Hammond and White, 2008). Also, a decrease in photosynthetic pigments in the seedlings grown in p-vc-co medium can be a cause of TSS accumulation. Despite the fact that TSS accumulation inhibited photosynthesis due to a decrease in phloem transport (Lemoine, 2013), there was a significant and negative correlation (-0.468^{*}) between TSS and POX (Table 4). Because the amount of peroxidase enzyme increased in adverse conditions to reduce the amount of ROS, the culture media that produce seedlings with lower amounts of TSS is more suitable than the other culture media.

Auxin is a plant hormone that promotes plant growth. The amount of auxin, which is synthesized from the amino acid tryptophan (Kasahara, 2016), in seedlings grown in p-vc-pp was higher than the seedlings grown in other culture media. When compared to pm-vc-pp, seedlings grown in p-vc-co medium had lower auxin levels (Figure 4) and growth (Table 2). Because nitrogen is essential for the construction of auxin, the lower amount of auxin in seedling grown in p-vc-co medium can be attributed to the lower nitrogen content of coco peat compared to palm peat (Table 1). Also,

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seedlings growth in p-vc-co medium was lower than in pm-vc-pp, which could be attributed to less nitrogen absorption from the medium. As a result, the seedlings produced fewer auxins. Less auxin was found where the seedlings had the weakest root and shoot growth under control. Auxin and N function as signaling molecules that promote root growth and help plants absorb more nutrients (Marchive *et al*., 2013).

CONCLUSIONS

Seedlings grown in p-vc-co medium, without palm peat, had the lowest quality, as well as the lowest greenness index (SPAD) and auxin content. Among the various culture media, seedlings grown in pm-vc-pp had the greatest root and shoot qualities. As a result, our findings suggest that using 60% palm peat in the composition of culture media can reduce the consumption of non-local resources such as peat moss and coco peat. Because palm peat is produced locally in Iran, its usage as a component of culture media can reduce imports of peat moss and coco peat, lower cultivation media prices, and optimize production costs. Furthermore, it has a fair possibility of producing high-quality seedlings. According to our findings, specific medium properties such as pH and organic matter may have a significant impact on the amount of nutrients added. Perlite, on the other hand, may have low micronutrients surface absorption. Under such conditions, the results may be inconsistent. While peat moss, vermicompost, and palm peat have pH values near 6.7, perlite and coco peat have pH values that are more difficult to modify (almost 7.0-7.8). These findings suggested that palm peat could be a viable alternative media in cucumber growing.

REFERENCES

1. Ainiwaer, M., Ding, J., Kasim, N., Wang, J. Z. and Wang, J. J. 2020. Regional Scale Soil Moisture Content Estimation Based on Multi-Source Remote Sensing Parameters. *Int. J. Remote Sens.,* **41:** 3346–3367.
2. Albalasmeh, A. A., Berhe, A. A. and Ghezzehei, T. A. 2013. A New Method for Rapid Determination of Carbohydrate and Total Carbon Concentrations Using UV Spectrophotometry. *Carbohydr. Polym.,* **97(2):** 253-261.
3. Ali, M., Griffiths, A. J., Williams, K. P. and Jones, D. L. 2007. Evaluating the Growth Characteristics of Lettuce in Vermicompost and Green Waste Compost. *Eur. J. Soil Biol.,* **43:** 316-319.
4. Alikhani, H. and Mohammadi, L. 2008. A Comparison of Physical and Chemical Properties of Vermicompost and Cold-Compost and the Effect of Their Use on Tomato Growth Indicators. *J. Agric. Sci. Technol.,* **39(1):** 201-207.
5. Benabderrahim, M. A., Elfalleh, W., Belayadi, H. and Haddad, M. 2018. Effect of Date Palm Waste Compost on Forage Alfalfa Growth, Yield, Seed Yield and Minerals Uptake. *Int. J. Recycl. Org.,* 7: 1–9.
6. Członka, S., Kairytė, A., Miedzińska, K. and Strąkowska, A. 2021. Polyurethane Composites Reinforced with Walnut Shell Filler Treated with Perlite, Montmorillonite and Halloysite. *Int. J. Mol. Sci.,* 22: 7304.
7. Dhen, N., Abed, A. B., Zouba, S., Haouala, F. and AlMohandes, D. 2018. The Challenge of Using Date Branch Waste as a Peat Substitute in Container Nursery Production of Lettuce (*Lactuca sativa* L.). *Int. J. Recycl. Org.,* **7:** 357–364.
8. Ebrahimi, R., Souri, M. K., Ebrahimi, F. and Ahmadizadeh, M. 2012. Growth and Yield of Strawberries under Different Potassium Concentrations of Hydroponic System in Three Substrates. *World Appl. Sci. J.,* **16(10):** 1380-1386.
9. Faostat, 2020. Food and Agriculture Organization of the United Nations. Crops, F. http://www.fao.org/faostat/en/#data.
10. Faostat, FAOSTAT. Food and Agriculture Organization of the United Nations. Crop. Prod. Data 2021.

[DOI: 10.22034/JAST.26.3.655]

Available online: https://www.fao.org/faostat/en/#data/QCL

11. Farrokhi, E., Samadi, A. and Rahimi, A. 2021. Evaluation of Antioxidant Activity, Total Phenol and Flavonoid Content of Lemon Balm (*Melissa officinalis* L.) in Different Cultures under Hydroponic Conditions. *Ecophytochemi. J. Med. Plants (EJMP)*, **8(4):** 19-33.
12. Hammond, J. P. and White, P. J. 2008. Sucrose Transport in the Phloem: Integrating Root Responses to Phosphorus Starvation. *J. Ext. Bot*, **59(1):** 93–109.
13. Ilahi, W. F. F. and Ahmad, D. 2017. A Study on the Physical and Hydraulic Characteristics of Cocopeat Perlite Mixture as a Growing Media in Containerized Plant Production. *Sains Malaysiana,* **46(6):** 975-980.
14. Kamrani, M. H., Hashemimajd, K., Najafi, N. and Hoseinnia, H. 2014. Effect of Planting Bed and Soilless Media on Growth and Yield of Potato Minitubers. *Agroecol. J.,* **10(3):** 25-35.
15. Kasahara, H. 2016. Current Aspects of Auxin Biosynthesis in Plants. *Biosci. Biotechnol. Biochem.,* **80(1):** 34-42.
16. Katsuhara, M., Otsuka, T. and Ezaki, B. 2005. Salt Stress Induced Lipid Peroxidation Is Reduced by Glutathione S-Transferase, But This Reduction of Lipid Peroxidase Is Not Enough for a Recovery of Root Growth in *Arabidobsis*. *Plant Sci.,* **169(2):** 369-373.
17. Lemoine, R., Camera, S. L., Atanassova, R., Dédaldéchamp, F., Allario, T., Pourtau, N., Bonnemain, J. L., Laloi, M., Coutos-Thévenot, P., Maurousset, L., Faucher, M., Girousse, C., Lemonnier, P., Parrilla, J. and Maurousset, L. 2013. Source-to-Sink Transport of Sugar and Regulation by Environmental Factors. *Front. Plant Sci.,* **4**: 272.
18. Lichtenthaler, H. K. and Buschmann, C. 2001. Chlorophylls and Carotenoids: Measurement and Characterization by UV-VIS Spectroscopy. In: "*Current Protocols in Food Analytical Chemistry". John Wiley and Sons. Inc.,* F4.2.1-F42.6.
19. Lu, B., Wang, X., Liu, N. and Hu, C. 2021. Prediction Performance Optimization of Different Resolution and Spectral Band Ranges for Characterizing Coco-Peat Substrate Available Nitrogen. *J. Soil Sediment.,* **21**: 2672–2685.
20. Marchive, C., Roudier, F., Castaings, L., Bréhaut, V., Blondet, E., Colot, V., Meyer, C. and Krapp, A. 2013. Nuclear Retention of the Transcription Factor NLP7 Orchestrates the Early Response 702 to Nitrate in Plants. *Nat. Commun.,* **4**: 1713. 2650.
21. Mazaheri Tirani, M., Madadkar Haghjou, M., Sulieman, S. and Ismaili, A. 2018. Comparative Evaluation of Zinc Oxide Effects on Tobacco (*Nicotiana tabacum* L.) Grown in Different Media. *J. Agric. Sci. Technol.,* **20**: 787-802.
22. Michael, P. I. and Krishnaswamy, M. 2014. Membrane Damage and Activity of Antioxidant Enzymes in Response to Zinc and High Irradiance Stress in Cowpea Plant. *Int. J. Curr. Res. Acad. Rev.,* **2:** 112-128.
23. Mohammadi Ghehsareh, A. 2013. Effect of Date Palm Wastes and Rice Hull Mixed with Soil on Growth and Yield of Cucumber in Greenhouse Culture. *Int. J. Recycl. Org. Waste Agric.,* **2:** 1–5.
24. Mohammadi Ghehsareh, A., Hematian, M. and Kalbasi, M. 2012. Comparison of Date-Palm Wastes and Perlite as Culture Substrates on Growing Indices in Greenhouse Cucumber. *Int. J. Recycl. Org. Waste Agric.,* **1:**1-5.
25. Mohammadi Ghehsareh, A. and Kalbasi, M. 2012. Effect of Addition of Organic and Inorganic Combinations to Soil on Growing Property of Greenhouse Cucumber. *Afr. J. Biotechnol.,* **11(37):** 9102-9107.
26. Mohammadi Ghehsareh, A., Samad, N. and Borji, H. 2011. Comparison of Date-Palm Wastes and Perlite as Growth Substrates on Some Tomato Growing Indexes. *Afr. J. Biotechnol.,* **10(24):** 4871-4878.
27. Nadarajah, K. K. 2020. ROS Homeostasis in Abiotic Stress Tolerance in Plants. *Int. J. Mol. Sci.,* 21: 5208.
28. Rahbarian, P., Sardoei, A. S., Gholamshahi, A. S., Khorshidi, S. and Jandi, J. 2014.

[DOI: 10.22034/JAST.26.3.655]

Relative Water Content, Cell Membrane Stability, Essential Oil and Morphology 50 of *Dracocphalum moldavica* L. Are Influenced by Drought Stress and Manure. Department of Horticultural Sciences, MSc. Thesis, Islamic Azad University, Jiroft Branch, Iran. (in Persian).
29. Resende, M. L. V., Nojosa, G. B. A., Cavalcanti, L. S., Aguilar, M. A. G., Silva, L. H. C. P., Perez, J. O., Andrade, G. C. G., Carvalho, G. A. and Castro, R. M. 2002. Induction of Resistance in Cocoa against *Crinipellis perniciosa* and *Verticillium dahliae* by Acibenzolar-S-Methyl (ASM). *Plant Pathol.,* **51**: 621–8.
30. Sachdev, S., Ansari, S. A., Ansari, M. I., Fujita, M. and Hasanuzzaman, M. 2021. Abiotic Stress and Reactive Oxygen Species: Generation, Signaling, and Defense Mechanisms. *Antioxidants*, **10**: 277.
31. Shirani, M. and Mohammadi-Ghehsareh, A. 2013. Effect of Date-Palm Waste as Culture Media on the Growth of Tomato. *Aust. J. Basic Appl. Sci.,* **7(8):** 29-32.
32. Singh, A. and Singh, G. S. 2017. Vermicomposting: A Sustainable Tool for Environmental Equilibria. *Environ. Qual. Manag.,* **27**: 23–40.
33. Tirani, M. and Haghjou, M. 2019. Reactive Oxygen Species (ROS), Total Antioxidant Capacity (AOC) and Malondialdehyde (MDA) Make a Triangle in Evaluation of Zinc Stress Extension. *J. Anim. Plant Sci.,* **29**: 1100-1111.
34. Vogt, T. 2010. Phenylpropanoid Biosyntesis. *J. Plant Mol*., **3:** 2-20-29.

پاسخ‌های مورفوفیزیولوژیکی نشاء‌های *Cucumis sativus* L. به محیط‌های کشت مختلف

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چکیده

محیط‌های کشت حاوی مواد مختلفی هستند که بر رشد و نمو گیاه تأثیر می گذارند. بنابراین یافتن بهترین محیط کشت در میان مواد مختلف اهمیت زیادی در بهره‌وری گیاهان دارد. این پژوهش در قالب طرح کاملا تصادفی با هشت تیمار و سه تکرار انجام شد. تیمارها شامل نسبت‌های ۶۰:۱۰:۳۰ از پرلیت- ورمی کمپوست- کوکوپیت، پیت ماس -ورمی کمپوست- پالم پیت، کوکوپیت -ورمی کمپوست- پالم پیت، پرلیت -ورمی کمپوست- پالم پیت و نسبت‌های ۷۰:۳۰ از پیت ماس -پالم پیت، کوکوپیت -پالم پیت، پرلیت -پالم پیت و ورمی کمپوست -پالم پیت بودند. بذر خیار در گلدان‌های حاوی محیط‌های کشت مذکور در شرایط گلخانه کشت شد. پس از مرحله چهار برگی واکنش‌های مورفوفیزیولوژیکی نشاء‌ها مورد ارزیابی قرار گرفت. بر اساس یافته‌های این تحقیق، در مقایسه با محیط کشت پرلیت-ورمی‌کمپوست-کوکوپیت، محیط کشت پیت ماس-ورمی کمپوست-پالم پیت، وزن تر اندام هوایی را ۵/۵ برابر، وزن تر ریشه را ۴/۵ برابر، وزن خشک ریشه را ۵/۸ برابر، وزن خشک اندام هوایی را ۷ برابر، قطر ساقه را ۱/۷ برابر، طول ساقه را ۲/۳ برابر، طول ریشه را ۱/۳

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برابر و سطح برگ را ۳/۸ برابر افزایش داد. با این حال، در مقایسه با نشاءهای کشت شده در محیط کشت حاوی پیت ماس-ورمی‌کمپوست-پالم پیت، میزان اکسین و گونه‌های اکسیژن فعال کاهش یافت در حالیکه کل قندهای محلول و پراکسیداز نشاءهای رشد یافته در محیط کشت پرلیت- ورمی- کمپوست-کوکوپیت افزایش یافت. به طور کلی یافته‌های ما نشان داد که ترکیب (۶۰:۱۰:۳۰) پیت ماس- ورمی‌کمپوست-پالم پیت می‌تواند به عنوان یک محیط کشت مفید برای بهبود کیفیت نشاء خیار در شرایط گلخانه مورد استفاده قرار گیرد.

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