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Comparison of date-palm wastes and perlite as culture substrates on growing indices in greenhouse cucumber

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Abstract

Different substrates have several materials which could have direct and/or indirect effects on plant growth and development. Therefore selecting the best substrate between the various materials is imperative to plant productivity. This research was carried out with using a completely randomized design with three treatments and seven replications. The treatments were including perlite, date-palm waste and soil. During plant growth irrigation rate, temperature, humidity, pest control for all treatments were similar. *Cucumis Stativus* cultivar was used for seeds. During plant growth Papadopolus formula with fertigation method used for nutrient solution. Some physiochemical characteristics of cultivation substrates were measured. The growth indices of cucumber plant were measured at the end of growth period. Results showed that higher amount of yield, biomass weight, SD, plant height, root weight, LAI and fruit TSS related to date-palm waste that had a significant difference with soil at 5% level but generally had not any significant difference at 5% level as compared with perlite substrate.

Keywords: Date-palm waste, Perlite, Substrate, Greenhouse, Cucumber

Introduction

In the recent years a wide range of soilless culture techniques have been developed and commercially introduced for intensive production of horticultural crops, particularly in greenhouses. Reasons for replacing soils as growing media arise from plant protection problems with soil-borne pathogens and environmental regulations against groundwater pollution with nitrate and pesticides. The use of soil in protected agriculture is facing many limitations in this country. Therefore, utilizing substrate-based agriculture is a logical alternative to the current soil-based production approach in the country. The use of different organic and inorganic substrates allows to the plants for best nutrient uptake and sufficient growth and development to optimize water and oxygen holding (Verdonck et al. 1982). However, different substrates have several materials which could have direct and/or indirect effects on plant growth and development. Therefore, selecting the best substrate among the various materials is imperative to the plant productivity (Olympios 1995). Replacing

soilless growing systems with soil growing for plants especially for cucumber, pepper, tomatoes and other vegetables cause control of plant nutrition and eliminate of plant diseases that caused by soil (Olympios 1995). Permuzic and et al (1998) showed the quality and quantity of tomato fruit in the organic media is better than inorganic media. The results of Inden and Torres (2004) on tomato when it cultured in the different substrates showed that the highest amount of total yield and number of fruit were related to Perlite + Rice hull and highest amount of total soluble solids (TSS) related to the Cocopeat substrate. In the other study on tomato plant with perlite and Lica substrates showed that the highest yield and average weight of fruit related to lica media with 12times/days irrigation period that this treatment had not any significant difference with 8 times/day (Shahinrokhsar et al. 2007). Maximum yield of dry weight was in media include soil + peat (v/v = 50) and sand + peat (25:75) at flowering stage and production fruit (Abdoallahi et al. 2007). Tomato plants were cultivated on five substrates (rockwool, perlite, and mixtures of perlite to zeolite 1:1, 1:2 and 2:1) in soilless culture with an open system and observed that the highest yield performance obtained by the mixture of perlite and

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zeolite with 1:1 ratio and highest flowering obtained by perlite substrate. The tomato plants that grown in perlite and zeolite with 2:1 ratio had the best distribution of fruit size, total soluble solid and sensorial quality and so highest dry matter of fruit was found in the perlite substrate (Djedidi et al. 2001). Alifar et al. (2010) investigated the effect of five different growing media including pure Cocopeat, Perlite-Cocopeat(50–50 v/v), Perlite-Cocopeat-Peatmoss (50-20-30 v/v and 50-30-20) and Perlite-Peat moss. Results showed the highest yield of cucumber fruit was obtained from Cocopeat and the lowest one was obtained from Perlite-Cocopeat. The other growth indices such as the largest stem diameter, the highest biomass, the highest fruit's number and the highest fruit's size and diameter were obtained from Cocopeat. The effect of the substrate on yield and fruit quality of tomato in soilless culture studied by Tzortzakis and showed that Plants grown in pumice and perlite substrates obtained lower total yield; and higher yield was obtained from maize substrate. Pumice + 50% maize and 100% maize produced higher total number of fruits per plant. Fruit quality parameters such as mean of fruit weight, fruit firmness, total soluble solid, titrable acidity, ascorbic acid and carotenoids were influenced by substrates, while they had not any effect on EC, pH and dry matter content. The results suggested that addition of maize to perlite and pumice could improve properties of inorganic substrates for tomato soilless culture, leading to higher yields and better of quality fruit (Tzortzakis et al. 2008). Samiei and et al investigated the effect of peat moss and date-palm wastes as substrates on growing of *Aglaonema* and his result showed that peat moss and date-palm peat were similar in some characteristics such as CEC, pH, EC and organic carbon but water holding capacity in peat moss was higher than date-palm peat. If this characteristic of date-palm peat improve, it would be a proper substitute in the future (Samiei et al. 2005). Date-palm extensively exist in the world and Iran and produce a lot of residues and wastes per annum. Currently, appropriate management and optimize procure is not to use this material at now. It seems that residues and wastes of date-palm can used as a substrate in greenhouse cultivation; therefore, it decrease problem of date-palm owners same fire. With attention to much development of greenhouse cultivations and using of substrate in greenhouses, the objective of the present research is study of date-palm waste and residues as a substrate and its effect on yield and quality of greenhouse cucumber in soilless culture.

Materials and methods

This research was carried out in the research greenhouse of Islamic Azad universit, khorasgan branch, using a completely randomized design with three treatments and seven replications. The treatments were including

perlite, date-palm waste and soil. Average temperature of day and night were 30°C and 18°C respectively and proportional humidity was 37/1-61/2%. During plant growth irrigation rate, temperature, humidity, pest control for all treatments were similar. The *Cucumis Stativus* cultivar was used for seeds. During plant growth Papadopolus formula with fertigation method used for nutrient solution (Papadopolus 1991 and 1994; Benton Jones J, 2005) that adjusted its pH until 5.5 to 6. The Physiochemical characteristics of culture media including bulk density, total porosity, WHC and CEC were measured (Baruah and Barthakur (1998), Rhoades (1982; 1988)). Amount of pH and electrical conductivity (EC) was measured in verdonck method (1992). Some growth indices including stem diameter, height of plant, dry and wet mass of plant, dry and wet mass of root, TSS of fruit and fruit yield were measured at the end of growth period. The analysis of all data was done by SPSS statistical software and the comparison of the averages was done by Excel.

Result and discussion

Substrates

Some physiochemical properties of substrates presented in Table1. The soil texture was sandy loam and its bulk density was higher than other substrates. The amount of bulk density in Palm peat was minima (0.041%); therefore, root media aeration in this treatment is better than others. Porosity percentage that is an index for root media aeration was high for Palm peat substrate (85%) and it was low for soil (37%). When root media aeration is sufficient, supply of water and nutrient elements for plants is easily. The amount of EC (Electric Conductivity) in soil was more than other substrates and this term in Perlite was lower than other treatments but according to amount of leaching requirement (20%), it seems that differences of EC in substrates had not important effects.

Amount of CEC in substrates very different and higher and lower amounts related to Palm peat and Perlit respectively; therefore, the Palm peat media had more capacity for supplement of nutrient elements for plant.

Growing indexes of plant

Amount of cucumber yield in different substrates had significant difference at 5% level. Higher amount of yield related to Palm peat media that had not any difference with Perlite media but they had a significant difference

Table 1 Comparison of physiochemical properties of substrates

Substrate	bulk density (%)	Porosity (%)	EC (ds/m)	pH	CEC (Cmol/kg)
Palm waste	0.041	85	1.28	6.7	95
Perlite	0.32	48	0.38	6.9	13
Soil	1.25	37	2.3	7.1	43.1

Table 2 Some growing indices of cucumber that cultivated in different media

Substrate	Fruit yield (kg)	ABP(W) gr	ABP(D) gr	SD mm	Height cm	Root weight(w) gr	Root weight(D) gr	LAI Cm ²	TSS (Brix%)
Palm	25.68a	550.2a	88.44a	18a	328.1a	30.3a	3.5a	277.2a	3.0a
Perlite	22.72a	350.7b	41.95b	8.1b	234.2b	23.3a	3.3a	181.7c	3.7a
Soil	12.77b	297.9b	41.91b	9.2b	258.9b	11.4b	1.8b	236.2b	3.1a

Definitions : LAI = Leaf Area Index , TSS = Total Solution Solid , ABP = Aerial Biomass of Plant , W = Wet , D = Dry, SD = Stem Diameter.

with soil. Amount of plant biomass in wet and dry condition in different substrates had not any significant differences at 5% level. Amount of stem diameter (SD) of cucumber plant in Palm waste media was more than other substrates (18 mm) and had significant differences at 5% level as compared with other media and so comparison of means showed that results of plant height were similar to SD. Sufficient conditions with a view to bulk density and porosity in palm peat media caused to good support of water and nutrient elements for plant and leading to good growth. The results of Alifar and et al. (2010) indicated that yield of cucumber fruit, plant stem diameter, biomass, fruit's number and fruit's size and diameter was obtained from Cocopeat media. They connected this results to preference of physiochemical properties of Cocopeat as compared with other media such as Perlite.

The physiochemical properties in date-palm media were better than others that cause to increasing in growing indexes. The low amount of bulk density and the high amount of porosity related to date-palm media that allowed the plant root penetrate in substrate easily and it could use more volume and space of media, thus available water and nutrient elements were sufficient for plants grow up in this media. Also the amount of CEC in date-palm media were higher than others. This term related to nutrient elements' buffer capacity that have an essential role in plant supplement. The amount of physical indices of perlite were between palm and soil; therefore, physiochemical properties of substrates affected on plant growing indices and tend to above results. The effect of substrates include Perlite, date-palm peat, date-palm peat + Perlite and Coco peat + Perlite on growing indices of tomato studied by Mohammadi Ghehsareh et al. (2010) and results showed that the yield of tomato fruits and TSS had not any significant differences between treatments at 5% level. Generally, Coco peat and Palm peat media with aspect to physiochemical characteristics had not any significant differences on growing of *Aglaonema* plant (Samiei et al. 2005).

Conclusions

Results of last investigations showed that coco peat and perlite were sufficient substrates for growing of some plants especially for vegetables and grower use this materials as growing media in greenhouse cultures. Also, the results of this investigation indicated that Perlite and

date-palm waste media had similar properties and they had not create any significant difference on qualitative and quantitative indices in cucumber fruit. Thus, with considering to low cost, availability and abundance of date-palm cultivation in Iran (242000 ha), it seems that date-palm wastes can be replaced with perlite media for growing of certain vegetable in Iran.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors read and approved the final manuscript.

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