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Effects of the Substrate on Tomato in Soilless Culture

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Abstract: Hydroponics culture have many advantages such as increased yield, health and uniform product, conservation of water and land , better protect , control of environmental pollution and reduce of workers for cultivation. So in recently years, usage of organic and inorganic substrates obtained more important for greenhouse owners and researchers. The aim of this study was Effects of culture substrate on tomato yield and fruit quality in soilless cultivation. This study has done in the greenhouse of Islamic azad university of khorasgan in iran. The treatments were date-palm peat 1(whithout fermentation period), date-palm peat2 (with three month fermentation period), perlite, cocopeat + date-palm peat2(v/v=50%), cocopeat+date-palm peat 1(v/v/=50%), perlite +date-palm peat 2(v/v=50%), perlite +date-palm peat 1(v/v=50%), cocopeat +perlite. The experiment was conducted in a randomized design with 6 replications. Papadopolus formula used for nutrient solution during plant growth with fertigation method. As well as temperature, humidity and irrigation rate was constant for all treatments. Comparison of means showed that the media had not significant effect on fruit weigh, fruit number and stem length in all treatments. Minimum and maximum fruits of yield related to date-palm peat2+perlite treatment and perlite respectively. The maximum fresh weight of plant related to date-palm peat+ cocopeat treatment that had not any significant difference with date-palm peat 2+cocopeat treatment ,Palm Peat 2 + perlite and palmpeat1 treatments. Maximum total soluble solids related to date-palm peat2+perlie treatment that has significant difference with palm peat1 treatment but had not any significant difference with other treatments. Also media had not significant effect on titrable acidity and ascorbic acid. Maximum pH related to date-palm peat1+perlite treatment that had not any significant difference with other treatments. The results showed that date-palm peat is a appropriate media for soilless culture with suitable physical and chemical properties ,availability and low cost. Therefore it can be a new substrates that introduce for replacing with other media.

Key words: soilless, media, substrate, date-palm peat, Total soluble solids, Titrable acidity , Ascorbic acid, fermentation.

INTROUCTION

In recently years some problems in soil culture (such as salinity and unsuitable soil characteristics) and limitation of water resources in many countries, especially in Iran, causes to expand soilless culture. 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 [10]. Permuzic and etal showed the quality and quantity of tomato fruit in the organic media is better than inorganic media[11]. Result of Inden and Torres on tomato when it cultured in the different substrate showed that highest amount of total yield and fruit numerous related to Perlite + Rice hull and highest amount of total soluble solids (TSS) related to Cocopeat substrate[19]. Effects of different substrates on growth, yield and quality of watermelon that growth in soilless culture studied by Yetisir and etal and they showed that highest vegetative growth was observed in the basaltic mix, sand, peat and soil substrates

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respectively. The weakest growth occurred in the mix of andesitic tuff and peat, While the highest and lowest yield was obtained from perlite and andesitic tuff , mix of basaltic tuff substrates respectively. Quality and quantity of watermelon fruit had not any significant difference between different substrates[20]. Effect of combination of some substrates such as Perlite and compost with soil for tomato plant studied by Javanpour and etal. Their result showed that quality and quantity of tomato in the different substrates that used soil treatment had not any significant differences[7]. In the other study on tomato plant with perlite and Lica substrates showed that 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 [14]. 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[1]. Dubsky and Sramek used rockwool as a substrate and observed that it had not any significant effect on the growth as compared with control[5]. 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 highest yield performance obtained by the mixture of perlite and zeolite with 1:1 ratio and highest flowering obtained by perlite substrae. The tomato plants that grown in perlite and zeolite with 2:1 ratio had best distribution of fruit size, total soluble solid and sensorial quality and so highest dry matter of fruit was found in perlite substrate[4]. 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[16]. Increase of ammonium nitrogen to the nutrient solution can be reduce amount of total soluble solid, titrable acidity and ascorbic acid fruits[3]. Samiei and etal investigated 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[13]. The results of use of zeolite, vermiculite and some organic materials as media for hydroponic tomato production showed that the lowest yield were obtained from the rice hull and mixtures of rice hull with other materials. The highest of yield, shoot dry weight and number of cluster per pot were obtained from cocopeat and perlite+mica media[12]. 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 and therefore it decrease problem of date-Palm owners same fire . The objective of this study was using of data-palm waste and residues as a substrate and its effect on yield and quality of greenhouse tomato(Newton) in soilless culture.

METHOD AND MATEREALS

This study has done in a period of seven months in soilless culture in the greenhouse of Islamic azad university of khorasgan in iran 2009. Plants cultured in bag with 105 *30 cm dimensions and 42 liters capacity that was appropriate for 2 tomato plant. The experiment was conducted in a randomized completely design with 8 treatments and 6 replications. Average temperature of day and night were 30 and 18 c^0 respectively. During plant growth irrigation rate, temperature, humidity, pest control for all treatments were similar. During plant growth Papadopolus formula with fertigation method used for nutrient solution. In this study cocopeat, perlite and two types of date-Palm media as substrates were used. At first waste of date-palm collected , clean and crushed(type 1) then added some water , nitrogen and phosphate fertilizers. After mixing, this materials put in the plastic bag with 1.5 m^3 volume. Some holes create on plastic bag for aeration. This materials mixed and its moisture controlled every week at once and this action regularly repeated for three months. Finally it prepared as type 2 date-palm peat. The treatments were including date-palm peat 1(whithout fermentation period), date-palm peat2 (with three month fermentation period), perlite, cocopeat + date-palm peat2(v/v=50%), cocopeat+date-palm peat 1(v/v/=50%), perlite + date-palm peat 2(v/v=50%), perlite + date-palm peat 1(v/v=50%) and cocopeat + perlite. Bulk density (BD), porosity and water holding of substrates were measured by Verdonck and Gabriels[17] methods. pH and electrical conductivity (EC) was measured in verdonck[18]. Nitrogen was analyzed by Kjeldahal method,and carbon was measured with walkly-black methods. Some

physiochemical properties of media showed in Table 1. Some characteristics of fruits include weight, pH of juice , total soluble solid (TSS), titratable acidity (TA), and ascorbic acid (vitamin C) content were measured. Amount of TA was measured by titration with 0.1N sodium hydroxide. Ascorbic acid in tomato juice was determined by (A.o.A.C) method. Diameter and length of stem measured by caliper and meter respectively. Total fruit weight and total fresh weight of plant was measured with a digital scale. Number of fruits determined in during of growth time. Data were analyzed with SPSS and comparison of means determined by Duncan system.

RESULTS AND DISCUSSION

Comparison of means showed that yield of fruits had not any significant difference between treatments(table 2). Highest amount of fruit yield related to perlite treatment (4.179 kg) that had not any significant difference with date-Palm peat 1 (3.842 kg) and date-Palm Peat 2 (3.830 kg) treatments. It related to the physical properties of substrate. Maximum and minimum amount of fresh weight of plants related to date-palm peat1+ perlite(1.8 kg) and perlite (1.1 kg) treatments respectively and date-Palm peat 1 had significant difference with perlite and palmpeat 2 treatments at 5% level but other treatments had not any significant difference. The substrates had not any significant difference on stem length of plants (Table 2). The highest and lowest amount of plant stem related to date-Palm Peat 1+ perlite and date-palm peat1 treatments with a mean 311.5 and 276.6 cm respectively. Other authors resulted that different substrates have not effect on stem length of tomato(5). Highest amount of stem length in date-Palm Peat1 + perlite substrate than other treatments maybe related to better aeration that affect on root oxygen demand and eventually cause more absorption of water and nutrient elements.

- Comparison means of stem diameter of tomato plants showed that maximum stem diameter related to date-palm peat2+cocopeat that had not any significant difference with date-palm peat1 and date-palm peat2 treatments. Minimum stem diameter related to perlite treatment that had significant difference with date-Palm Peat 2 + perlite treatment. This results is similar to Maloupa and Shinohara reports(Maloupa et al, 2001, Shinohara et al, 1999).
- Number of fruits had not any significant difference between treatments. Maximum and minimum number of fruits related to date-palm peat 2+cocopeat and date-palm peat1+ cocopeat treatments.
- The substrates had significant difference on TSS of fruit at 5% level. Maximum and minimum amount of TSS related to dare-palm peat2+ perlite(7 B^0) and date-palm peat1treatments. Amount of TSS in tomato fruit in date-palm peat 1 and date-palmpeat2+ perlite treatments had significant difference at 5% level but other treatments had not any significant difference together. This difference maybe related to availability of nutrient elements in different media. High concentrations of ammonium in solution can be reduce TSS(9) and Increasing in macro elements concentration resulted in increasing of TSS of tomato fruits[8].
- Date- palm peat1+perlite treatment had maximum amount of pH and have significant difference at 5% level with other treatments (table2). Effects of media on titrable acidity (TA) of tomato fruit had not any significant difference between treatments. Maximum and minimum amount of TA related to palm 1 (1.386%) palm peat1 + perlite (.88%) treatments respectively. This results agree with results of Javanpour and etal[7].
- Amount of Ascorbic acid (vitamin C) in tomato fruits in different treatments had not any significant difference. The highest amount of vitamin C related to date-palm peat 1(17.4%) and datr-palm peat 2 (18%) treatments. Also the lowest amount of vitamin C was related to date-palm peat1+perlite (14%) treatment.

Table 1: Some physicochemical properties of media

substrate	C/N%	Pdg/cm	pH	ECds/m	porosity%	Water Hold capacity %
Cocopat	48.47	.16	6.73	2.9	58	90.48
Perlite	0	.13	7.8	1.6	68	69.7
Date-Palmpeat1	63.57	.16	6.5	2.25	91	78.25
Date-Palmpeat2	54.76	.17	6.73	3.18	83	83.5

Table 2: Comparison means of quality and quantity characteristics of tomato fruit in different substrates.

media	Fresh Weigtgh plant (kg)	Yield (kg)	fruit Number	Diameter	Stem Stem (mm)	pH Length (cm)	Vit-C	TA %	TSSB^0 %
Palmpeat2+perlite	1.43ab	3.25a	60.1a	17.37b	277.6a	4.01a	15.2a	1.30a	7b
Palmpeat2+cocopeat	1.82b	3.40a	69.6a	20.176b	282a	4.18bc	16.8a	1.29a	6.25ab
Perlite+cocopeat	1.72b	3.68a	69.3a	18.4ab	288.6a	4.04abc	15.4a	1.27a	6.125ab
Palmpeat1+cocopeat	1.82b	3.79a	58a	18.57ab	293a	4.04ab	16.35a	1.37a	6ab
perlite	1.13a	4.17a	69.3a	15a	299a	3.98a	17a	1.05a	6.37ab
Palmpeat2	1.43a	3.83a	66.3a	15.2a	285.8a	4.09abc	18a	1.26a	6.25ab
Palmpeat1+perlite	1.82b	3.72a	65.6a	16.64ab	311.5a	4.2c	14a	0.88a	6.125ab
Palmpeat1	1.76b	3.84a	61.3a	18.45ab	276.6a	4.11abc	17.4a	1.38a	5.375a

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