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Date Palm Waste Application as Culture Media for Strawberry and its Impact on Some Growth Indices and Yield Components

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ABSTRACT

In order to investigate the possibility of replacing Coco peat as cultivation substrate with date palm wastes, this study was conducted by using 2 cultivars of strawberry plant using hydroponic cultivation system in a commercial hydroponic greenhouse placed at Narega village, Boyerahmad. The study was carried out using factorial experiment with a completely randomized design of 5 cultivation substrate treatments (date palm waste with particles 0-5 mm, date palm waste with particles 5-10 mm, date palm waste with particles10-20 mm, date palm waste mixed with particles (50% 0-5 mm particles, 30% 10-20 mm particles, and 20% 5-10 mm particles),and a mixture of coco peat and perlite (V/V=50) (as control). Studied cultivars were 'Marak' and 'Queen'. During plant growth, humidity and temperature of different substrates were kept constant. Vegetative growth characteristics such as number of runners per plant, leaf number, plant height, leaf area, chlorophyll index and plant performance were measured. The results showed that cultivars had different effects in different cultivation substrates and with different particle sizes of palm cultivation substrate. Also, the result indicated that the highest growth and yield belonged to date palm culture media with 0-5mm particular size, which was not significantly different from Coco peat- perlite cultivation substrate.

Keywords: Chlorophyll index, coco peat, leaf area, medium, runner.

INTRODUCTION

Agricultural sector is the major water consumer in the world. Given the current serious water shortage especially in dry and semi-dry areas, some restrictions are in place for the use of this vital resource. Therefore, cultivation in greenhouse and protected environments are on the rise as it is considered as an effective approach to increase production and decrease water consumption. (Akbari and Dehghani-Sanich, 2007) In most regions of the world including Iran, hydroponic greenhouses are equipped with open soilless cultivation system and within the systems nutrient solution are not recycled after passing through root zone and culture media. Therefore due to their simplicity and easier management of nutrition solution, eliminate waste are more common (Delshad et al., 2011; Shahinrokhsar et al., 2007). Now, various substrates are being applied for greenhouse cultivation systems to reduce leakage.

In addition to having desirable physical-chemical and biological characteristics, a suitable substrate must be available, relatively cheap, stable, and light enough, so that working with it will be easier. In addition, in terms of transportation, it must be cost-effective. In comparison to other substrates, some of these substrates are more advantageous in terms of providing plant requirements and increased yield. (Borji, 2010) In temperate climates, strawberry is one of the best small fruits and in recent decades it has become an important commercial product. Because of its odor, taste, richness in vitamins, it has found its rightful place in the diet of millions of people throughout the world. (Kashi and Hekamti, 1991) Cultivation of strawberry in greenhouses has led to increased yield per acre, earlier supply time, easier pest control, as the result of decrease in the use of chemicals, and higher quality. In the hydroponic cultivation of strawberry, the major substrate consists of perlite and coco peat. Given that coco peat is obtained from coconut tree, which cannot be cultivated in Iran, every year huge amounts of money are spent to import coco peat from other countries. On the other hand, palm, which belongs to the same family as coconut does, is considered an important product in Iran. According to statistics given by the Iranian Ministry of Agriculture, in 2008, about 244,000h of

country lands were allocated to palm cultivation and annually considerable amounts of palm wastes are discarded without being put to optimum use. Palm wastes have higher water holding capability than coco peat and can absorb water 8.5 times its dry weight. Developing the technology of the optimum use of palm wastes as substrate in hydroponic cultivation can save the country huge amounts of money on importing coco peat and can have an important role in the sustained development of agriculture sector (Hesami et al., 2010).

Investigating the effect of perlite and palm peat substrates, palm peat plus perlite and coco peat plus perlite on tomato growth, mohammadi-Ghehsareh et al. found that there is not any significant difference between treatments in terms of fruit yield and total soluble solid. They also held that coco peat and palm peat as substrate in terms of physiochemical characteristics show no significant difference in the growth of *Aglonema* plant. Shahinrokhsar et al., (2007) considered the effect of 4 substrates on the performance and some other indexes of strawberry in soilless cultivation. The findings indicated that plants cultivated in cocopeat substrate brought about improvement in such growth indexes as dry and fresh weight of plant (g in plant), chlorophyll and number of fruit (number of plant), which did not have any significant difference with woodchips substrate.

Deilamghani-Hsanlui and Hemati, (2011) considered the effect of various substrates on the rate of nutrients, yield, and quality characteristics of strawberry cv 'Selva' in soilless cultivation and showed that the highest yield, and the highest number of flowers and fruits belonged to perlite and coco peat substrates with volume proportions of 25-75 and 50-50, which showed significant differences with other treatments. Nutrient comparison of means present in fruits showed that the highest amounts of N and K were present in perlite and coco peat treatment with volume proportion of 0-100 and the highest amounts of K and Mg were present in perlite-coco peat treatment with volume proportion of 0-100. Amerisiahuni et al. (2011) investigated the effect of substrate and cultivar on the growth indexes of strawberry such as leaf area and petiole length in soilless culture. The findings indicated the fact that the kind of substrate has a significant impact on such growth indexes such as number of runners, leaf area and petiole length and that vegetative growth was higher in short day cultivars than ever bearing cultivars.

Samiei et al. (2005) investigated the effect of peat moss and date-palm wastes as substrates on growing of *Aglaonema* and their results 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. They concluded that if this characteristic of date-palm peat improves, it would be a proper substrate in the future (Samiei et al., 2005).

Different substrates have several materials which could have direct and/or indirect effect on plant growth and development. Therefore, selecting the best substrate among the various available materials is imperative to the plant productivity (Olympious, 1995). Replacing soilless growing systems with soil growing for plants especially for cucumber, pepper, tomatoes and other vegetables controls plant nutrition and eliminates plant soil borne diseases (Olympious, 1995). Therefore the aim of this study was to investigate the effect of date palm wastes as culture media on some growth indices and yield components of two strawberry cultivars.

MATERIALS AND METHODS

This experiment was performed to investigate the effect of date palm wastes substrate particles size on fruit characteristics (both qualitatively and quantitatively) in two greenhouse strawberry cultivars produced by hydroponic soilless culture in a greenhouse stablished in Nargah village of Boyer Ahmad province, Iran.

Culture Conditions:

The study was conducted during one culture period of 5 months by pot culture. During the plant growth period, the environment humidity and temperature were kept constant for all treatments in every planted pot. Average day temperature was 18-25 °C and average night temperature was 15-18 °C and relative humidity in the greenhouse ranged from 50 to 60%. This greenhouse was equipped with necessary equipment to gather meteorological data such as a thermometer for recording temperature at a certain time and maximum and minimum temperatures, a hygrometer for recording the relative humidity in the greenhouse as well as an air-conditioning system.

Experimental Design and Treatments:

The experiment design included 5 treatments of substrates and 2 cultivars. The study was conducted on a completely randomized design with 5 replications. In total, 50 pots were used. Pots had a total capacity of 5 liters each for cultivation purposes and in each pot, only a single strawberry plant was planted. In this study, substrate treatment was made of substrates of coco peat, perlite and date palm wastes with particles size of 0-5 mm, 5-10 mm, 10-20 mm, and mixture of palm peat (50% of the particles 0-5 mm, 30.% of the particles 10-20 mm, and 20% of the

particles 5-10 mm in size)(Table 1). At first, wastes of date palm trees were gathered from palms in Farrashband, Fars province and were crushed by a machine to become homogenous. Following that, for sizing purpose, sieves were used to separate the crushed wastes into three different sizes of 0-5 mm, 5-10 mm, and 10-20 mm. Coco peat is supplied in compact forms in the market. Lukewarm water was added to the pieces of coco peat before being used. The substrate treatments were as follows:

A) Date Palm wastes with particles 0-5 mm.
B) Date Palm wastes with particles 5-10 mm.
C) Date Palm wastes with particles 10-20 mm.
D) Date Palm wastes with mixture of particles (50% of the particles 0-5 mm, 30% of the particles 10-20 mm, 20% of the particles 5-10 mm)
E) Coco peat and perlite (V/V=50) as control.

The studied strawberry cultivars were 'Queen' and 'Marak'. During the experiment, 2 stock solutions were prepared and used as vegetative and reproductive solution (Table 2).

Table 1. Some physical and chemical characteristics of the used substrates.

Substrates and Size	WHC (%)	Total porosity (%)	pH	EC (dsm^{-1})	CEC ($Cmolkg^{-1}$)
Palm 0-5	74.35	79.9	7.1	3.4	26.1
Palm 5-10	28.06	86.3	6.95	2.3	25.4
Palm 10-20	18.72	90	7.01	2.4	22.3
Palm Mixed Particles	24.12	88.8	7.14	2.4	25
Coco Pat + Perlite	42.11	83	7.3	1.4	23.4

Table 2. Nutrient concentration for strawberry in hydroponic culture (Lentmorgan, 2005).

Element	Concentration in vegetative solution (mgl^{-1})	Concentration in reproductive solution (mgl^{-1})
	Macro-Elements	
N	207	182
P	65	82
K	184	301
Ca	221	148
Mg	58	58
S	77	77
	Micro-Elements	
B	0.7	0.7
Cu	0.07	0.07
Fe	6.5	6.5
Mn	6.2	6.2
Mo	0.05	0.05
Zn	0.25	0.25

In order to lower pH, Nitric Acid 45% was added to the above solution.

Irrigation regime was determined as required and on the basis of the length of the day, the temperature of the environment, and water drained out of the pots. At first, the plants prepared were planted in the pots on the basis of the experimental design. They were irrigated with ordinary water for 10 days. Once the plants were established, they were fertigated with basic vegetative solution for 15 days until they were almost uniform and equal in height. Irrigation was done three times a day at first, each time 250 ml. Later on, depending on the environment temperature, water drained out of the pots, EC and pH of the water, it was increased to four times with the amount of 350 ml. All changes in fertigation and irrigation were made uniformly for all pots.

Characteristics:

The number of leaves, the number of runners, and chlorophyll index in growth period were measured. Plant height, leaf area and yield of the plant were measured at the end of growth period. The measurement of leaf area was carried out with a leaf area meter model Am Med 100-200, USA. Determination of leaf chlorophyll content was carried out with a Spade-Minolta, Japan. The yield of every plant was determined by the number of fruits in very plant and the average weight of fruit in the same plant. Plant height was measured with a ruler and the number of leaves and the number of runners were determined by counting them during the growth period. After the data were collected, they were entered into the EXCEL software as a database. Consistent with the hypotheses

formulated in the study, the analysis of the data was conducted through MSTATC Software, using completely randomized blocks. The comparison of means was conducted through Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Number of Runners:

The analysis of variance revealed that the effect of the kind of substrate on number of runners of both strawberry cultivars was significant (p<1%). However, the effect of the cultivar was not significant (Table 3).

The comparison of means through Duncan Test showed that between different substrates treatments, the highest number of runners (8.5) belonged to the coco peat and perlite treatment and the lowest (7) belonged to the palm treatment with particle size 0-5mm and mixture of particles. In addition, there was no significant difference among other treatments (Table 4).

Table 3. ANOVA of the vegetative index of strawberry treated with different substrates.

Sources of Variation	DF	Squares					
		No. of Runners	No. of Leaves	Plant Height	Leaf Area	Chlorophyll	Yield
Substrate	4	4.130**	90.47**	7.58**	148.7 ns	36.281*	15159.85*
Cultivar	1	2.00 ns	89.78ns	0.09ns	1307.6**	76.385**	1044.24*
Substrate× Cultivar	4	0.650 ns	2.23 ns	0.09ns	22.9ns	*29.250	65.22ns
Error	40	0.980	24.08	1.65	206.5	9.673	255.04
Coefficients of Variation		13.31	10.03	6.75	9.42	7.05	11.66

ns not significant, *significant at p<5%, ** significant at p<10%

Coco peat substrate, with its good conservation capacity of water and nutrients and perlite with very little cation exchange capacity, and high capacity of water absorption could be considered as ideal substrates in soilless culture (Djedidi et al., 1999). Therefore, the combination of these two factors leading to high capacity of conservation of nutrient solution, easier exchange of elements, especially cations in the substrate and suitable moisture distribution, is very effective in the root zone. This is in turn effective in the growth indexes of the root, including the number of runners. In addition, palm substrate with particle size of 5-10 mm with coco peat + perlite substrate did not show a significant difference in terms of the number of runners, which is an indication that its performance was not different from the performance of the latter substrate. Amerisiahuei et al. (2011) found that the kind of substrate is effective in the number of runners. This is consistent with the findings of the present study. In Amerisiahuei et al. (2011) study, the highest number of runners (3) belonged to Vermicompost treatment (25%), perlite (35%), and coco peat (40%); whereas the lowest number belonged to the treatment of button wood pruning wastes. Posstchi et al. (2004) reported that the kind of substrate had an impact on the vegetative characteristics of strawberry such as the number of runners.

Table 4. The effect of different substrates on the number of runners, leaves, plant height, leaf area and chlorophyll content of strawberry.

Treatment	No. of Runners	No. of Leaves	Plant Height (cm)	Leaf Area (cm^2)	Chlorophyll Index	Yield (g/plant)
Palm 0-5 mm	7.1[b]	34.1[a]	20.03[a]	157.06[a]	46.83[a]	186.08[a]
Palm 5-10 mm	7.6[ab]	28.4[ab]	18.5[ab]	152.09[a]	45.53[ab]	111.69[d]
Palm 10-20 mm	7.00[b]	27.2[b]	18.12[b]	147.83[a]	42.77[b]	89.08[e]
Palm mixed particles	7.00[b]	30.1[ab]	18.63[ab]	149.93[a]	42.52[b]	134.48[c]
Coco peat + perlite	8.5[a]	33.3[a]	19.9[a]	155.68[a]	42.99[ab]	163.68[b]

Table 5. The effect of different strawberry cultivars on the number of runners, leaves, plant height, leaf area and chlorophyll content.

Treatment	No. of Runners	No. of Leaves	Plant Height (cm)	Leaf Area (cm^2)	Chlorophyll Index	Yield (g/plant)
Marak	7.24[a]	31.96[a]	18.90[a]	147.4[a]	45.32[a]	132.43[b]
Queen	7.64[a]	29.28[b]	19.16[a]	157.63[a]	42.85[b]	141.57[a]

Number of Leaves:

Analysis of variance revealed that the effect of the kind of substrate on the number of leaves was significant whereas the effect of cultivar was not significant (Table 2).

Comparison of the means through Duncan Test indicated the fact that between substrate treatments, the highest leaf number belonged to palm substrate with particles size of 0-5 mm and lowest number belonged to palm substrate with the particle size of 10-20 mm. There was no significant difference among the other treatments (Table 4).

Most growth indexes such as leaf number show positive correlation with substrate moisture conservation capacity. Generally speaking, plants showing resistance against dry weather, can remain free from its adverse effects. One of the apparent reactions of the plants toward dry weather is early senescence of leaves and early leaf abscission. This results in the reduction of precipitation. It seems that the substrate with water conservation capacity for water containing nutrients is in a better position to keep the water and the nutrients until the next irrigation, thus, creating better conditions for growth. That is why palm peat (0-5 mm) had a significant effect on the number of leaves, which has been due to its high moisture conservation capacity whereas palm peat substrate 10-20 mm did not have a significant effect on the number of leaves, which has been due to its large number of pores, leading to its decreased water conservation capacity.

The findings of a study by Shahinrokhsar et al. (2007) on the effect of substrate type on the vegetative characteristics of strawberry in hydroponic culture showed that leaf number was a function of substrate, which is consistent with the findings of the present study. They found that the highest leaf number (77) belonged to coconut substrate and the lowest belonged to perlite and wood chips substrate (46.06). Samiee et al. (2005) found that organic substrates had a significant impact on growth indexes so much that the highest leaf number belonged to coco peat and the lowest belonged to sugarcane bagasse whereas peat moss and palm peat substrates did not show any significant difference. Hesami et al. (2010) reported that the leaf number is a function of substrate so that the highest leaf number belonged to perlite treatment and the lowest belonged to palm treatment.

Plant Height:

Analysis of variance revealed that the effect of the substrate kind on plant height was significant whereas the effect of cultivar was not significant (Table 2). Comparison of the means through Duncan Test revealed the fact that between different substrates, the highest height belonged to palm treatment (20.30 cm) with particle size of 0-5 mm and the lowest (18.20 cm) belonged to palm treatment with particles size 10-20.This was while 0-5 mm particles did not show any difference (Table 4).

It seems that the substrates that have higher cation exchange capacity result in an increase in plant height. This is because this capacity leads to higher capacity of nutrients and better water management (Shahinrokhsar et al., 2007). Therefore, 0-5 palm particles had a significant impact on the growth, which is due to its high capacity of cation exchange. In a study on the effect of irrigation regime and substrate on the growth indexes of tomatoes Shahinrokhsar et al. (2007) showed that there was no significant difference among the substrates under investigation in terms of plant height. They also found that the effect of substrates on plant height was more significant than that of irrigation regime. Samiee et al. (2005) showed that the highest plant height belonged to sugarcane bagasse and the least plant height to coco peat substrate.

Leaf Area Index:

Analysis of variance revealed that the effect of the cultivar on leaf area index was significant whereas the effect of substrate was not significant (Table 2). Comparison of the means through Duncan Test was indicated that between different substrates treatments, the highest leaf area index (157.632) belonged to the 'Queen' cultivar and the lowest (147.404) belonged to the 'Marak' cultivar (Table 5).

Amerisiahei et al. (2011) investigated the effect of substrate and cultivar on the growth indexes of strawberry and showed that cultivar has a significant impact on leaf area index, which is consistent with the findings of the current study. They showed that the most leaf area (54.3cm^2) belonged to the 'Camarosa' cultivar and the lowest (46.96) to the 'Selva' cultivar.

Chlorophyll Index:

Analysis of variance revealed that the effect of the substrate and cultivar on the chlorophyll index was significant in strawberry (Table 2). Comparison of the means through Duncan Test revealed that between different treatments, the highest index of chlorophyll belonged to palm substrate treatment with particles size of 0-5 mm and the least chlorophyll index (42.520) belonged to the treatment of the mixture of palm particles. Also, this figure was higher in 'Mark' cultivar (45.328) than 'Queen' cultivar (42.856) (Table 4 and 5).

Previous studies have showed that lack of water affects leaf morphology, which has in turn affected leaf chlorophyll, eventually resulting in chlorophyll

content reduction (Antolin et al., 1995). So palm peat substrate 0-5 mm with high water conservation capacity has had positive effect on chlorophyll.

The findings of a study by Shahinrokhsar et al., (2007) on the effect of four types of substrate on the vegetative characteristics of strawberry in hydroponic cultivar showed that there was no significant difference among the substrates in terms of impact on chlorophyll, which is consistent with the findings of the present study. They found that the highest chlorophyll index was that of perlite substrate (42.9) and the lowest that of perlite and woodchips mixture substrate (37.7).

Yield:

Analysis of variance revealed that the effect of substrate kind on the yield of strawberry was significant at P<1% and that the effect of cultivar was significant at P<5% (Table 2). Comparison of the means through Duncan Test revealed the fact that between different substrate treatments, the highest yield (186.08 g/plant) belonged to palm treatment with particle size of 0-5 mm and the lowest yield (89.08 g/plant) belonged to palm treatment with particle size of 10-20 mm. The results suggested that coco peat + perlite treatment was the second best treatment in terms of performance after palm (0-5 mm in size) treatment, followed by palm treatment with mixture of particles and palm treatment of 5-10 mm (Tables 4 and 5).

In order to achieve good yield, every plant requires strong vegetative growth and enough nutrients. This growth is possible when the roots are capable of absorbing enough water and nutrients (Turhan and Atilla, 2004). Substrate physical characteristics such as water conservation capacity and total pores can be effective in strawberry growth indexes. It seems that the palm substrate size of 0-5 mm (with high water conservation capacity) could create good growth conditions for strawberry, which results in high yield.

Hesami et al. (2010) investigated the various substrates in strawberry media and found that treatment with 2 parts of perlite plus one part of coco peat plus one part of palm petiole had the highest yield (88.88 g/plant) and the treatment with palm petiole, the treatment with one part of coco peat and one part of palm petiole had the lowest yield of 20.08 and 22.05, respectively.

Amerisiahuei et al. (2011) investigated the effect of substrate and cultivar on the growth indexes of strawberry. They found that substrates with Vermicompost (15%), perlite (40%), and coco peat (45%) had the highest yield (236.6) whereas the lowest yield belonged to the substrate of button wood pruning wastes. They also reported that the cultivar had an impact on the yield. Specifically, the 'Marak' cultivar had the highest yield (213.9) and the 'Selva' cultivar had the lowest (170.4). Alifar and Mohamadi-Ghahsareh, (2010) studied the effect of substrate type on the performance of greenhouse cucumber and found that the highest fruit yield was observed in coco peat substrate (6.82 kg/plant) and perlite + coco peat (6.54 kg/plant). However, the difference with other treatments was not significant.

REFERENCES

Akbari, M. and H. Dehghani-Sanich. 2007. Principles of design, planning, and exploitation management of micro irrigation system in greenhouse plants. First Technical Workshop of Water Consumption Efficient Gradation with Green House Products Cultivation. pp: 1-35.

Alifar, N. and A. Mohamadi-Ghahsareh. 2010. Effect of cultivation substrate type on performance and absorption of some nutrients elements by greenhouse cucumber in soilless cultivation. Greenhouse Cultivation Sciences and Techniques. 1: 1-6.

AmeriSiahuni, A., A. Sh. Tehranifar and M. Davari Nejad. 2011. Considering effect of cultivation substance and kind on strawberry growth characterization in soilless cultivation system. Iran Esfahan Agriculture Sciences. Esfahan University of Technology Press, Esfahan, Iran. pp: 1-3.

Antolin, M.C., J. Yollerand and M. Sanchez-Diaz. 1995. Effect of temporary drought on nitrate fed and nitrogen fixing in alfalfa plants. Plant Science. 107:159-165.

Borji, H. 2010. Effect of palm peat cultivation substrate on greenhouse tomato yield in soilless cultivation. Ph.D. Thesis. Tehran University, Tehran, Iran. pp: 1-127.

Deilamghani-Hsanlui, M. and S. Hemati. 2011. Effect of various cultivation substrates on rate of nutrients, strawberry quality characterization, and performance of 'Selva' cultivar in soilless cultivation. Greenhouse Cultivation Sciences and Technics. pp: 6-19.

Delshad, M., R. Alfatahi, T. Sadat Taghva and M. ParsiNejad. 2011. Water consumption efficient improvement with irrigation time management (giving solution) in strawberry soilless cultivation. 25 (1):18-24

Djedidi, M., D. Gerasopoulos and E. Maloupa. 1999. The effect of different substrates on the quality of 'Carmelo' tomatoes (*Lycopersicom esculentum* Mill.) grown under protection in a hydroponic system. Cahier Option Mediterranneenes. 31: 379-383.

Hesami, A., F. Amini, S. Sarikhani-Khorami and A. Birghadr-Kashkooli. 2010. Palm wastes utilities as substituting for coco peat in strawberry hydroponic cultivation. Second Agriculture National Meeting and Stable Development, Front Opportunities and Challenges. 2-3 March. Shiraz, Iran.

Kashi, A. and J. Hekamti. 1991. Strawberry Breeding. Ahmadi Publication. Tehran. pp: 10-25.

Mohammadi-Ghehsareh, A., H. Borji and M. Jafarpour. 2011. Effect of some culture substrates (date-palm peat, coco peat and perlite) on some growing indices and nutrient elements uptake in greenhouse tomato. African Journal of Microbiology Research. 12: 1437-1442.

Morgan, L. 2005. Strawberry Soilless Cultivation. Jahad Daneshgahi Publication, Mashad, Iran. 216p.

Olympious, C.M. 1995. Soilless media under protected cultivation rockwool, peat, perlite and other substrates. Acta Horticulturae. 401:443-451.

Postchi, M., A. Tehranifar, H. Arooi and H. Nemati. 2004. Considering effect of 7-cultivation environment on some quality and quantity characterizations of three strawberries kind in soilless cultivation environment. M.A Thesis. Agriculture College. Firdausi University. Mashhad, Iran. pp: 25-65.

Samiee, L., A. Khalifi, S. Samavat and M. Arghavani. 2005. Considering exploitation possibility from cellulose as peat moss substitute in *Aglonema* ornamental herbs cultivation substrate. Iran Agriculture Science Magazine. 36 (2): 503-510.

Samiee, L., A. Khalifi, S. Samavat and M. Arghavani. 2005. An investigation of substitution of peat moss with palm tree celluloid wastes in growing Aglaonema (*Aglaonema Commutatum* Cv. 'Silver Queen'). Iranian Journal of Agricultural Science. 36(2):503–510.

Shahin-Rokhsar, P., K. Davari, GH. Peivast, B. Ghahreman and H. Nemati. 2007. Considering effect of off-irrigation and cultivation substrate on performance of some tomato growth parameters in soilless cultivation. Agriculture Engineering Researches Magazine. 8: 31-46.

Turhan. E. and E. Atilla. 2004. Effect of chloride application and different media on ionic strawberry plants under salt stress conditions. Soil. Science Plant Analysis. 36: 1021-1028.