SINAI Journal of Applied Sciences 10 (3) 2021 315-328

Available online at www.sinjas.journals.ekb.eg

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SINAI Journal of Applied Sciences

Print ISSN 2314-6079
Online ISSN 2682-3527

ARU-EGYPT SJAS Trust Science | It Creates

EFFECT OF SOME ALTERNATIVE SOLID SUBSTRATE MEDIA ON VEGETATIVE GROWTH CHARACTERISTICS OF TOMATO

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ARTICLE INFO

Article history:
Received: 21/09/2021
Revised: 11/10/2021
Accepted: 04/11/2021
Available online: 04/11/2021

Keywords:
Tomato,
soilless,
growth media,
law plastic tunnels,
pressed olive cake.

ABSTRACT

Field experiments were conducted to evaluate the suitability of using some materials derived from agricultural and agriculture industrial wastes as alternative growth media for tomato cultivation grown under low plastic tunnels. Field trials were conducted at the Experimental Farm, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai, Egypt under low plastic tunnels during winter growing seasons of 2017/2018 and 2018/2019. This study included sixteen treatments (five substrate media, *i.e*, sand, sawdust, pressed olive cake, crashed wheat straw and vegetative green waste compost) and their combinations at a ratio of 1:1 (V/V) as well as coco peat as a control medium. The chemical properties of these substrates and their effects on plant growth were studied. Results indicated that addition of coco peat was the best growing media for vegetative growth (number of leaves/plant, plant height, number of branches/plant, root, as well as fresh and dry weight of tomato in both seasons at 40 days after transplanting. However, at 65 days after transplanting pressed olive cake +wheat straw medium was the superior treatment, since recorded the highest values for the studied traits in the first season. However, in the second season, the highest number of leaves and branches /plant were achieved with green waste compost + sand medium, while the highest plant height value was recorded with coco peat medium. Green waste compost, pressed olive cake + green waste compost, sand and sawdust medium showed the highest value for each of fresh and dry weight. Meanwhile, total leaves chlorophyll contents, in general, were the best with pressed olive cake + green waste compost medium in the first season, while green waste compost + sand medium recorded the highest content of Chlorophyll in the second season. Also, wheat straw and pressed olive cake, as well as, their combination showed the highest concentration of nitrogen and phosphorus in leaves of tomato plants.

INTRODUCTION

Tomato (*Solanum lycopersicum* Mill.) is one of the most important vegetable crops of Solanaceae grown universally. It is one of the most popular vegetable crops consumed all over the world and an important source of minerals, vitamins, antioxidants and healthy acids (**FAO, 2007**). Soilless cultivation is recognized globally for its ability to support efficient and intensive plant production. Its production systems vary, most utilize a porous substrate or growing medium for plant provision of water and nutrients, as well as an appropriate physical structure; a growing medium must provide a suitable biological and chemical environment in which plant roots can effectively access nutrients. It also needs to meet the practical and economic requirements of the grower; in short, it must be affordable, easy to obtain and manageable (**Barrett *et al.*, 2016**).

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https://doi.org/10.21608/SINJAS.2021.97276.1053

In the selection of new materials, environmental considerations have become as important as performance and economic cost. In this context there has been a justifiable emphasis on organic materials derived from agricultural, industrial and municipal waste streams (**Chong, 2005; Raviv, 2013**). The most investigated alternative to peat was compost, a renewable and local resource (**Kahn *et al*., 2005; Walker *et al*., 2006; Grigatti *et al*., 2007**). For the recycling of organic wastes and to decrease the amount of wastes that are not recycled and may end up being sent to landfill, the production of compost and its subsequent use in agriculture possess certain advantages. Vegetable wastes and animal manure are suitable for compost production (**Alkoaik and Ghaly, 2006; Vargas-García *et al*., 2006 and 2010, Kalamdhad *et al*., 2009; Gonz_alez-Fern_andez *et al*., 2015**).

Composts enhance the growth of plants as a consequence of the production of plant growth regulators (**Atiyeh *et al*., 2002**) and can suppress plant diseases (**Raviv, 2008; Bernal-Vicente *et al*., 2012; Vestberg *et al*., 2014**). In general, composted organic wastes have high nutrient contents and exhibit high ion exchange, which can reduce the need for mineral fertilizer use through increased fertigation efficiency (**Altieri *et al*., 2014**).

In Egypt, salinity, unsuitable soil and limitation of water resources consider some of the problems in soil culture, specially, in Arish region, North Sinai, Governorate. Therefore, the main objective of this study was to verify the potential of some organic media as alternative inexpensive and suitable media for production of tomato under low plastic tunnels in El-Arish region.

MATERIALS AND METHODS

Field experiments were carried out under low plastic tunnels during two successive winter growing seasons of 2017/ 2018 and 2018/2019 at The Experimental Farm, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai, Egypt to study the performance of tomato plants (Firmont F_1 Hybrid). Sixteen growth media treatments were evaluated (five substrate media and their combinations at a ratio of 1:1 (V/V) as well as coco peat as a control medium). These media were as follows: sand, sawdust, pressed olive cake crashed wheat straw and vegetative green waste compost. The experiment designed in a Randomized Complete Design (RCD) in three replications. Tomato seeds were sown in speeding trays on 23th October and transplanted 45 days later. Plants were transplanted in black plastic bags of 35 L size (100×25 cm dimensions) that was appropriate for two tomato plants. Drip irrigation system was used, each plot had one dripper line. The distance between plants in the same line was 50 cm. Plot area was 18 m^2 (15 m length and 1.2 m wide) planting density was 1.66 plants per m^2. The normal agricultural practices were carried out as commonly followed in El-Arish region. The chemical analyses of the irrigation water are presented in Table 1.

Composting procedure

The media of sand, sawdust, pressed olive cakes, wheat straw and vegetative green waste compost and their combinations were composted for three months before using aiming to complete the analysis for C/N ratio between 1:20, where media were mixed with chicken manure recommended quantities, composting process took place in aerated piles. Piles were manually turned in accordance with temperature evolution, and water was added to maintain moisture content near 60%. Chemical characters of each feedstock are presented in Table 2.

Table 1. Chemical analyses of irrigation water

		Soluble ions (meq.l^{-1})						
pH	**EC**	**Cations**				**Anions**		
	(ppm)	K^+	Na^+	Mg^{++}	Ca^{++}	Cl^-	$HCO3^-$	$CO3^{--}$
7.2	5170	21	44	25	10	95	5	--

Table 2. Some properties of studied media after composting (average of both seasons)

Treatment	**Organic matter**	**Organic C**	**Moisture Content**	**EC**	**pH**	**N**	**P**	**C/N ratio**
		(%)		**(dS/m)**		**(%)**		
Coco peat (control)	65.2	34.3	38.3	6.2	6.8	1.5	0.17	22.9
Sand	3.6	1.9	31.9	4.3	7.0	1.1	0.15	1.7
Sawdust	85.8	45.1	36.7	6.1	7.3	1.9	0.1	23.7
Wheat straw	52.2	27.5	40	7.8	7.3	1.9	0.49	14.5
Green waste compost	39.6	20.8	15.9	6.0	7.1	1.9	0.47	10.9
Pressed olive cake	82.8	43.6	32.4	7.2	7.0	3.9	0.85	11.2
Sand + sawdust	19.3	10.2	18.6	3.7	7.1	3.2	0.18	3.2
Sand + wheat straw	4.1	2.2	25	6.2	7.4	2.3	0.1	1.0
Sand + green waste compost	6.8	3.6	14.1	4.2	7.3	1.3	0.06	2.8
Sand + pressed olive cake	16.7	8.8	15.9	5.5	7.3	2.0	0.13	4.4
Sawdust + wheat straw	53.7	28.3	32.4	3.3	7.41	1.3	0.19	21.8
Sawdust + green waste compost	51.6	27.2	23.3	5	7.2	1.9	0.46	14.3
Sawdust + pressed olive cake	82.2	43.2	28.9	3.7	7.6	2.3	0.37	18.8
Wheat straw + green waste compost	22.9	12.1	17.5	6.5	7.2	2.5	0.21	4.8
Wheat straw + pressed olive cake	76.1	40.0	31.2	6.6	7.5	3.1	0.54	12.9
Green waste compost + pressed olive cake	54.2	28.5	18	4.7	7.3	2.6	0.56	11.0

Data Recorded

Chemical properties of substrate media

Moisture content (MC)

Each medium was dried at 105°C until constant weight then percentage of moisture content was estimated.

The Electrical conductivity (EC) and pH

Water extract (growing media sample: distilled water, 1:10 by weight/ volume); shaken for 15 min and left for 60 min, filtered, and the measurements were made using pH meter and EC meter, respectively

Organic matter content (%)

It was determined after aching in an oven at 550 °C, and the organic C was calculated (TOC=OM/1.9) as described by (**Nelson and Sommers, 1996**).

Nitrogen content (%)

It was determined according to the method described by **Bremner and Mulvaney (1982)**.

Phosphorus content (%)

It was calorimetrically determined using the Spectrophotometer (Model 6300 and 6100 Jenway Co.) according to **Olsen and Sommers (1982)**.

Vegetative growth parameters

Three plants from each plot area were randomly taken after 40 and 65 days from transplanting and the following data were recorded

1. Plant height (cm),
2. Number of leaves/plant,
3. No. branches/plant,
4. Fresh weight of stem, leaves and total fresh weight of shoot (stem+ leaves),
5. Dry weight of stem, leaves and total dry weight of shoot (stem +leaves). Different organs of tomato plant samples were oven dried at 70°C until constant weight and the dry weight of root, stem and leaves as well as total dry weight was calculated.
6. Leaves chlorophyll content: Leaflets from 20 mature fresh leaves were taken from each experimental unit at 65 days after transplanting, washed with distilled water to remove any residue. The pigments were extracted by soaking 200 mg of fresh leaves in 5 ml of N, N-Dimethylformamide (DMF) **Moran (1982)** in dark-colored glassware and storing them at a temperature of 4°C for 72 hours and then measured at the following wavelengths of 647 and 664using the spectrophotometry.
7. Nitrogen and Phosphorus content of leaves

Statistical Analysis

The obtained data were subjected to statistical analysis of variance according to **Snedecor and Cochran (1980)**, and means separation was done according to **Duncan (1955)**.

RESULTS AND DISCUSSION

Results in Table 3 indicate that there was a significant difference among substrate media on tomato plants growth for all studied traits; *viz.*, number of leaves/plant, plant height, and number of branches/plant. Coco peat medium showed the highest values of all studied parameters at 40 days after transplanting in both seasons, except plant height which was higher with pressed olive cakes+ sand and pressed olive cake+ green waste compost medium in the first season. Meanwhile, pressed olive cake +wheat straw medium was the superior treatment, since recorded the highest values for the studied traits at 65 days after transplanting in the first season. However, in the second season, the highest number for each of leaves and branches/plant were achieved with green waste compost + sand

Table 3. Effect of different substrate media on some vegetative growth traits of tomato plant at 40 and 65 days after transplanting during 2017/2018 and 2018/2019 seasons

Treatment \ Parameter	No. leaves/plant		No. branches/plant		Plant height (cm)		No. leaves/plant		No. branches/plant		Plant height (cm)	
	Days after transplanting											
	40	65	40	65	40	65	40	65	40	65	40	65
	First season (2017/2018)						Second season (2018/2019)					
Coco peat (control)	42a	76b	8.0a	22.5ab	47.5b	73.0b	36a	71b	10a	22.2a	57a	84a
Sand	25ef	34g	3.5g	11.0h	34.0d	52.5de	29cd	32h	8.2ab	19.2ab	49abc	70b
Sawdust	24f	37g	3.5g	11.5gh	31.0de	47.5ef	35a	55cd	7.7ab	12.2d	49abc	61bcd
Wheat straw	27def	52e	4.0fg	11.0h	34.0d	52.5de	27de	47g	5.0ab	11.8d	37ef	50fgh
Green waste compost	27def	60cd	5.0de	13.5ef	34.0d	59.0cd	26def	55cd	6.2ab	12.7d	38def	56d-g
Pressed olive cake	27def	55cde	4.5ef	11.0h	33.5de	49.5ef	24ef	50efg	5.4ab	15.6bcd	35ef	47gh
Sand + sawdust	34bcd	62c	4.5ef	19.5c	30.5e	64.5c	34ab	55cd	9.6ab	19.5ab	55ab	58def
Sand + wheat straw	28c-f	53de	5.5cd	12.5fg	33.5de	60.5c	26def	48fg	6.5ab	12.2d	37ef	57def
Sand + green waste compost	28b-f	57cde	3.5g	21.5b	41.5c	44.0f	27de	87a	6.3ab	22.8a	42c-f	44h
Sand + pressed olive cake	36ab	60cd	8.0a	19.5c	54.0a	59.5cd	24ef	29h	4.6b	15.0bcd	37ef	50fgh
Sawdust + wheat straw	26ef	38g	5.5cd	12.5fg	46.5b	52.5de	23f	33h	6.5ab	12.2d	47bcd	51e-h
Sawdust + green waste compost	27def	58cde	4.5ef	11.5gh	47.5b	58.5cd	24ef	53cde	5.5ab	10.5d	49abc	57def
Sawdust + pressed olive cake	32b-e	44f	4.5ef	8.5i	33.5de	45.0f	29cd	31h	5.1ab	12.2d	35f	43h
Wheat straw + green waste compost	29c-f	58cde	7.5a	16.0d	41.0c	72.0b	26def	53cde	8.7ab	14.8bcd	45b-e	68bc
Wheat straw + pressed olive cake	29c-f	92a	6.0bc	23.0a	45.5b	88.5a	27de	52def	4.7b	11.3d	33f	45h
Green waste compost + pressed olive cake	36ab	60cd	6.5b	14.5e	52.5a	63.0c	31bc	56c	6.7ab	18.3abc	35f	60cde

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of probability according to Duncan's multiple range test..

medium, while the highest plant height value was recorded with coco peat medium.

These results are in agreement with the findings of many researchers who reported that coco peat had significant effect on plant growth (**Peyvast *et al.*, 2010; Arias and Bustamant, 2014; Reshma and Sarath, 2017**). Also, olive mill waste medium (OMWM) therefore presents itself as a potential ingredient for the production of growth media in nursery cultivation (**Raviv *et al.*, 2007**). OMWM is capable of supplying the required nutrients to the plants as evidenced by a reduction in fertigation for nitrogen and potassium requirement. OMWM showed to be an effective and cheap alternative to standard growth media used in soilless cultivations leading to reduce production cost for growers. The relatively higher amounts of nutrients left in the growth media at the end of strawberry cultivation may also be recycled as an organic value-added product in agriculture (**Altieri *et al.*, 2010**). Also, tomato waste compost represents a source of organic matter, containing highly enriched plant nutrients such as nitrogen, potassium, and calcium and is a valuable organic feedstock (**Tabrika *et al.*, 2019**). Compost obtained from garden wastes are reported as successful organic material in peat substituted growing media (**Benito *et al*. 2005; Grigatti *et al*. 2007; Ribeiro *et al*. 2007**).

Generally, it could be said that application of coco peat medium was the best growing media for vegetative growth of tomato in both seasons at 45 days after transplanting. While, of pressed olive cake + wheat straw medium in the 1st season and sand + green waste compost medium in the 2nd Season considers the best growing media at 65 days after transplanting.

Results in Tables 4 show significant differences among treatments for fresh weight traits, *i.e*, leaves, branches and total / plant of tomato plant. Except, number of branche / plant, Coco peat was the superior treatment in both seasons at 40 days after transplanting. On the other side, at 65 days after transplanting, in the first season the best treatments were, green waste compost medium for leaves and total, pressed olive cake + wheat straw for branches/pant. Meanwhile, in the second season the medium of pressed olive cake and sand + green waste compost, sawdust and green waste compost were the best application for fresh weight of leaves, branches and total/ plant, respectively.

These results are in agreement with those reported by **Samiei *et al.* (2005)** who showed that dry and wet weight of plant biomass in plants cultured in peat moss and date-palm peat substrates was similar.

It could be concluded that the best treatment for increasing fresh weight of different organs of tomato plant was coco peat at 40 days in both seasons. Meanwhile, green waste compost and pressed olive cake increased fresh weight per plant at 65 days.

Results in Table 5 illustrate that there were significant differences among treatments for dry weight of leaves, branches and total / pant in tomato. The results indicated that, in the first season, application of coco peat medium was the superior treatment at 40 days after transplanting for the studied traits. While in the second season, both sand + sawdust and green waste compost + pressed olive cake medium recorded the

Table 4. Effect of different substrate media on fresh weight (g) of tomato plants at 40 and 65 days after transplanting during 2017/2018 and 2018/2019 seasons

Treatments \ Parameter	leaves/plant		branches/plant		Total plant		leaves/plant		branches/plant		Total plant	
	Days after transplanting											
	40	65	40	65	40	65	40	65	40	65	40	65
	First season (2017/2018)						Second season (2018/2019)					
Coco peat (control)	226a	348bc	94a	160bc	320a	508ab	192a	250def	57bcd	161d	249ab	411cde
Sand	142d	359b	58bcd	156bc	200c	515a	146b	204fg	68ab	156de	214c	360ef
Sawdust	159cd	208e	50def	165bc	209c	373cd	145b	209fg	51def	264a	196cd	473cd
Wheat straw	95efg	269d	57cde	160bc	152cd	429b	104d-g	268cde	57bcd	159d	161ef	427cde
Green waste compost	89e-h	430a	56cde	193ab	145cde	623a	92fg	329ab	56cde	246ab	148f	575a
Pressed olive cake	90e-h	292cd	51def	153bc	141def	445b	122cd	360a	69a	153def	191cd	513ab
Sand + sawdust	212ab	276d	69b	163bc	281b	439bc	188a	204fg	67abc	162d	255a	366ef
Sand + wheat straw	77e-h	313bcd	45efg	132cd	122efg	445bc	90gh	313bc	50def	132f	140g	445cd
Sand + green waste compost	82e-h	103g	57b-e	95de	139def	198ef	68i	360a	45ef	161d	113h	521ab
Sand + pressed olive cake	58h	124fg	43fg	69e	101fg	193f	74hi	224efg	59a-d	69gh	133gh	293gh
Sawdust + wheat straw	110e	135fg	55de	86e	165cde	221ef	113cde	244def	48def	75gh	161f	319fg
Sawdust + green waste compost	101ef	175ef	59bcd	135cd	160cde	310de	125c	190g	57bcd	135ef	182de	325fg
Sawdust + pressed olive cake	69fgh	130fg	38g	101de	107fg	231ef	112cde	185g	42f	89g	154f	274h
Wheat straw + green waste compost	182bc	375ab	68bc	136cd	250b	511ab	98efg	306bc	59a-d	237b	157ef	543ab
Wheat straw + pressed olive cake	61gh	116fg	35g	213a	96g	329ef	110c-f	283bcd	62abc	82g	172def	365f
Green waste compost + pressed olive cake	98ef	314bcd	56cde	61e	154cde	375cd	183a	310bc	68a	211c	251ab	521b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of probability according to Duncan's multiple range test.

Table 5. Effect of different substrate medium on dry weight (g) of tomato plants at 40 and 65 days after transplanting during 2017/2018 and 2018/2019 seasons

Treatments \ Parameter	leaves/plant		branches/plant		Total plant		leaves/plant		branches/plant		Total plant	
	Days after transplanting											
	40	65	40	65	40	65	40	65	40	65	40	65
	First season (2017/2018)						Second season (2018/2019)					
Coco peat (control)	75a	67cde	21a	33bc	96a	101c	41a	83bc	12a-e	37b	53a	121abc
Sand	28def	73cd	13bcd	33bc	41de	106c	30b	120a	14ab	34b	45b	154a
Sawdust	46bc	42f	11c-f	51a	58c	93c	29b	60cde	10cde	58a	40bcd	119abc
Wheat straw	27def	59e	12b-e	34bc	40ef	98c	22cde	78bcd	11b-e	34b	34c-f	112bc
Green waste compost	23ef	100a	12b-f	55a	36fg	155a	21def	88b	11b-e	53a	33def	141ab
Pressed olive cake	20ef	67cde	11c-f	30bcd	31ghi	97c	28bc	82bc	13a-d	32b	42bc	115bc
Sand + sawdust	18ef	65de	14bc	38b	33gh	104c	42a	55de	15a	35b	58a	91cd
Sand + wheat straw	37cd	67cde	10c-f	32bcd	47d	99c	18ef	68b-e	10de	29bc	28fg	97cd
Sand + green waste compost	19ef	31fgh	12b-e	26b-f	31ghi	57de	15f	68b-e	9e	35b	24g	103bcd
Sand + pressed olive cake	16f	24gh	9def	16ef	25hi	40e	16ef	74bcd	14abc	16d	30efg	90cd
Sawdust + wheat straw	31de	67cde	12b-f	18def	43de	85c	27bcd	70b-e	12a-e	16d	39b-e	86cd
Sawdust + green waste compost	50b	59e	12b-e	29b-e	62c	88c	29b	54de	13a-d	29bc	42bc	83cd
Sawdust + pressed olive cake	28def	31fgh	8ef	22c-f	36fg	53de	25bcd	49e	9e	19cd	34c-f	69d
Wheat straw + green waste compost	21ef	85b	16b	50a	37fg	135b	22cde	64b-e	14abc	56a	36c-f	121abc
Wheat straw + pressed olive cake	16f	20h	7f	14f	23 j	34e	21def	74b-e	14ab	19cd	35c-f	93cd
Green waste compost + pressed olive cake	56b	79bc	13bcd	57a	69b	136b	43a	65b-e	15a	50a	58a	115bc

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of according to Duncan's multiple range test.

highest values for these traits in the same period. Meanwhile, dry weight of leaves and total/plant at 65 days, in the first season, increased with green waste compost medium and significantly exceeded other treatments, while, dry weight of branches/ plant recorded the highest value with green waste compost + pressed olive cake medium. In contrast, in the second season, sand medium for leaves and total/plant as well as sawdust medium for branches/plant were the superior treatment approximately for increasing dry weight per plant.

Results in Table 6 show the effect of substrates media on some chemical traits of tomato leaves; *viz.*, chlorophyll a, chlorophyll b, chlorophyll a+b, N and P content in both seasons. In this respect, sand and pressed olive cake + green waste compost media recorded the highest values for each chlorophyll a, chlorophyll b, and chlorophyll a+b content for tomato leaves in the first season. on the other hand, green waste compost + sand medium recorded the superior values for tomato leaves involved of chlorophyll a, chlorophyll b and chlorophyll a+b content in the second season without significant differences than sand medium.

Nitrogen and phosphorus content involved in tomato leaves recorded the highest values with pressed olive cake + wheat straw medium in the first season. In the second season, wheat straw medium recorded the highest content of nitrogen while pressed olive cake medium recorded the highest value in the second season. These results are in agreement with **Dysko *et al.* (2009)** who studied the influence of nutrient solution on the nutritional status of tomato plants grown in soilless culture in organic medium and found that the highest concentration of nitrogen was proved in leaves of tomato grown in organic substrates such as straw. Also, These results are in agreement with **Ravindran *et al.* (2017)** who reported that composting progresses showed an increase in the content of available phosphorus, which make compost a valuable sources of plant available nutriment compared with the direct land-use livestock. **Tabrika *et al.* (2021)** studied optimization of tomato waste composting with integration of organic feedstock and found that mixtures containing chicken manure and olive pumice had higher phosphorus content. Respecting the order, our results also were in agreement with the previous studies of **Bergfeldt *et al*. (2018), Kamran *et al*. (2019), Ramphisa and Davenport (2020)**.

Conclusion

Considering the low cost, availability and abundance of organic substrates media, it seems that coco peat medium can be replaced with wastes media as alternative inexpensive media and suitable for production of tomato under low plastic tunnels in El-Arish region. In order to reduce cost of using imported expensive organic materials to be used in growing media in protected production, it is recommended that this study is extended to a wide range of plant species.

Table 6. Effect of substrates media on some chemical traits of tomato leaves 65 days after transplanting during 2017/2018 and 2018/2019 seasons

Parameter / Treatment	Chl. A (mg/g fw)	Chl. B (mg/g fw)	Chl. a+b (mg/g fw)	N %	P %	Chl. a (mg/g fw)	Chl. b (mg/g fw)	Chl. a+b (mg/g fw)	N %	P %
	First season (2017/2018)					Second season (2018/2019)				
Coco peat (control)	3.9abc	2.4ab	6.4bcd	2.7ab	0.37b	3.9abc	2.4abc	6.3a-d	2.2cde	0.36cde
Sand	4.3a	2.7a	7.1ab	1.5ef	0.33b	4.1a	2.5ab	6.7ab	2.1efg	0.36cde
Sawdust	3.2e	1.8c	5.0e	1.9cde	0.16e	3.5cd	2.1cd	5.7de	2.2cde	0.31ef
Wheat straw	3.1e	1.9c	5.1e	2.9a	0.34b	3.2e	2.0de	5.2ef	3.0a	0.44ab
Green waste compost	3.8bc	1.9c	5.7de	2.7a	0.26c	3.1e	1.8e	5.0f	2.8abc	0.38bcd
Pressed olive cake	3.3de	1.9c	5.2e	1.3f	0.23cd	3.7bcd	2.1cde	5.8cde	1.4g	0.46a
Sand + sawdust	3.8bc	2.4ab	6.3cd	1.9cde	0.2de	3.9abc	2.5ab	6.5abc	1.7efg	0.22h
Sand + wheat straw	3.8bc	2.4ab	6.3cd	2.1bcd	0.42a	3.7bcd	2.3abc	6.1bcd	2.2def	0.32def
Sand + green waste compost	4.2ab	2.7a	7.0abc	1.3f	0.21cde	4.2a	2.6a	6.9a	2.0efg	0.41abc
Sand + pressed olive cake	4.2ab	2.5a	6.8abc	2.0cde	0.17e	3.7bcd	2.2bcd	6.0bcd	1.6efg	0.28fgh
Sawdust + wheat straw	3.5cde	2.2bc	5.7de	2.7ab	0.32b	3.5de	2.2cd	5.7de	2.9abc	0.38bcd
Sawdust + green waste compost	3.8bc	2.5ab	6.4bcd	2.6ab	0.18e	4.0ab	2.6a	6.7ab	1.8efg	0.22h
Sawdust + pressed olive cake	4.1ab	2.6a	6.8abc	2.5abc	0.25c	3.7bcd	2.4abc	6.2bcd	2.8a-d	0.29fg
Wheat straw + green waste compost	3.3de	2.0c	5.3e	1.7def	0.34b	3.6bcd	2.2bcd	5.9cd	2.9ab	0.25fgh
Wheat straw + pressed olive cake	3.7cd	1.9c	5.7de	2.9a	0.45a	3.9abc	2.3abc	6.3a-d	2.2b-e	0.28fgh
Green waste compost + pressed olive cake	4.3a	2.7a	7.1a	2.1bcd	0.33b	3.9bc	2.4abc	6.3a-d	1.5fg	0.23gh

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of probability according to Duncan's multiple range test.

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الملخص العربي

تأثيــر بعـض البيئات الصلبـــــة البديلــة علــى صـــــفات النمـــو الخضــري للطماطم

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أجريت تجارب حقلية لتقييم إمكانية استخدام بعض المواد الناتجة من المخلفات الزراعية، والتصنيع الزراعي كبيئات نمو بديلة للطماطم في الزراعة تحت الأنفاق البلاستيكية المنخفضة. تم تنفيذ التجارب الحقلية في المزرعة البحثية بكلية العلوم الزراعية البيئية، جامعة العريش، شمال سيناء، مصر خلال الموسمين الزراعيين الشتويين 2018/2017 و2018/ 2019. واشتملت هذه الدراسة على ستة عشر معاملة عبارة عن خمس بيئات (الرمل، ونشارة الخشب، والمخلفات الصلبة لعصر الزيتون (تفلة الزيتون)، وتبن القمح، وكمبوست المخلفات النباتية الطازجة)، وجميع التوليفات الثنائية الممكنة بينها بنسبة 1: 1 (حجم/حجم) بالإضافة إلى معاملة الشاهد، وهي بيئة بيت جوز الهند. تم دراسة الخواص الكيميائية للبيئات وتأثيراتها على الصفات الخضرية فى نمو نبات الطماطم. أظهرت النتائج أن بيئة بيت جوز الهند كانت أفضل بيئة نمو للنمو الخضري لنبات الطماطم في الموسمين (عدد أوراق النبات، وارتفاع النبات، وعدد الأفرع للنبات، والوزن الطازج والجاف) بعد أربعون يوماً من الشتل. أما بعد خمسة وستون يوماً من الشتل، فإن استخدام بيئة تفلة الزيتون+ تبن القمح أعطت أحسن النتائج للصفات الخضرية في الموسم الاول، بينما بيئة كومبوست المخلفات النباتية الطازجة + الرمل كانت الأفضل في الموسم الثاني. بالنسبة للوزن الطازج للأوراق والفروع او النبات ككل كانت الزراعة في بيئات كومبوست المخلفات النباتية الطازجة منفرد او مخلوط مع تفلة الزيتون أو الرمل أو نشارة الخشب كانت هي الأفضل. بخصوص محتوى الأوراق من الكلوروفيل بصفة عامة كان أعلى محتوى مع الزراعة في بيئة كومبوست المخلفات النباتية الطازجة مخلوطة مع تفلة الزيتون في أول موسم أو مخلوطة مع الرمل ثاني موسم. أيضا بيئة تبن القمح أو تفلة الزيتون منفردين أو مخلوطين مع بعضهم أعطى أعلى تركيز من النيتروجين والفوسفور في أوراق نباتات الطماطم.

الكلمات الاسترشادية: الطماطم، الزراعة بدون تربة، بيئات الزراعة، الأنفاق البلاستيكية المنخفضة، تفلة الزيتون.