Egypt. J. of Appl. Sci., 37 (1-2) 2022 *1-17*

PRODUCING EGGPLANT BY USING SUSTAINABLE URBAN HORTICULTURE

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ABSTRACT

To create resilience city under the climate change impacts, the most successful strategy is urban agriculture. The need for satisfying food security, safety and accessibility becomes an urgent under Covid 19 epidemic.

Three fertilizing source (nutrient solution, mineral fertilizer and vermi-liquid) combined with two pots volume 6 and 8 liters of standard substrate peat moss: perlite (50:50) were evaluated on yield and fruit of eggplant during two successive summer seasons of 2019 and 2020 at the Central Laboratory for Agricultural Climate, Agricultural Research Center, Dokki, Giza Governorate. The study was aimed to investigate the eggplant production (yield and quality) under urban conditions in substrate culture (safety and economic). The number of total fruit for each plant was regularly counted during the harvested period. The total number of the leaves was counted during vegetative harvested period. Fruit diameter (cm) and fruit length (cm) was measured. Average of fruit weight (g) was calculated by marketable fruits weight divided to total number of the fruits, and N, P and K contents of eggplant were estimated beside determined the economic use.

The obtained results indicated that, the amounts and balance among the different essential nutrients led to enhance the vegetative growth and yield of eggplant compared to the rest fertilizer source. Chemical nutrient solution recorded the highest vegetative growth and yield characteristics of eggplant while the lowest results were given by vermi-liquid. While nutrient solution and mineral fertilizer increased N, P and K contents of eggplant compared to the vermi- liquid treatment. Increasing pot volume from 6 to 8 L of substrate led to increase the vegetative growth, yield characteristics of eggplant and N, P and K contents of eggplant. The highest vegetative growth, yield characteristics and N, P and K (%) content of eggplant were given by chemical nutrient solution combined with pots volume 8 L.

The use of vermi-liquid as a fertilizer source and pot volume 6 L performed a sustainable and economic impacts of urban horticulture

under climate change impacts and to ensure food security under Covid 19 epidemic.

Key Words: Urban horticulture, sustainable, vermi-liquid, substrate culture, chemical nutrient solution, eggplant.

INTRODUCTION

Urban horticulture is not a commercial activity aimed to achieve high profit. The real profit of urban horticulture lies in gifting cities the sustainability feature and maintains the supply of fresh and healthy food while avoiding the risks of climate change and various biological factors. The urban agriculture play an important role in facing the challenges of climate impacts on sustainable agriculture and food security in urban and peri-urban areas **(Gockowski *et al.,* 2003, Mawoisa *et al.,* 2011, Grewal & Grewal 2012, Probst *et al.,* 2012, Hara *et al.,* 2013, Abul-Soud *et al.,* 2014, Rego 2014, Wertheim-Heck *et al.,* 2014, Abul-Soud & Mancy, 2015, Abul-Soud 2015 and Bvenura & Afolayan 2015).**

Eggplant is a popular vegetable crop in Egypt. Eggplant has a high nutritious and healthy values.

Soilless growing media are simpler to deal with and may give a superior developing condition contrasted with soil **(Bilderback *et al.,* 2005 and Mastouri *et al.,* 2005).** A decent developing media ought to have a few qualities, for example, to give air circulation and water, and consider greatest root development and backing truly the plant **(Bilderback *et al.,* 2005).**

Many different organic and in-organic matters are used as growing media **(Olle *et al.* 2012).** Diverse developing materials are utilized to accomplish the right parity of air and water holding limit with regards to the plants to be developed just as for the drawn out steadiness of the medium **(Nair *et al.,* 2011). Ahmed, *et al.* (2017)** found that increasing pot volume from 4 to 8 L of substrate led to increase the vegetative and yield of celery and red cabbage.

The EC and pH of the nutrient solution is anything but difficult to modify so the plants get the perfect measure of supplements. The watering/taking care of cycles can be constrained by an economical clock with the goal that the plants get watered on time, as needed.

Extract from vermicompost is known as vermicompost extract. Vermicomposting determined fluids contain significant supplements that advance plant development. Substrates that have been utilized in these fluids creation are primarily creature and farming waste **(Pant *et al,* 2009 and Gutiérrez-Miceli *et al,* 2011).**

Accessible plant supplements that present in these fluids are significant and can possibly be utilized as supplements arrangement in hydroponics culture. **Quaik *et al,* 2012 (a and b)** reported that vermicomposting leachate, this bio-fertilizer showing promising results in various dilutions on Radish (*Raphanus sativus* L.) germination (%), number of leaves, plant height and shoot dry weight are most elevated in leachate of 10% dilution, while root dry weight is most elevated in leachate of 15% dilution **(Gutiérrez-Miceli *et al,* 2011). Atiyeh *et al* (2002) , Arancon *et al.,* (2007) , Shlrene *et al.,* (2012) and Karla *et al*., (2020)** revealed the effect of vermi-liquid as plant development controllers beside the nutrition value (**Edwards *et al.,* 2010**) on the plant development might be because of hormone-like movement related with the significant levels of humic acids and humates. Vermicompost increment the wholesome nature of some vegetable harvests, for example, tomatoes **(Gutiérrez-Miceli *et al*., 2007 and 2008)**, spinach **(Peyvast *et al*., 2008)**, strawberries **(Singh *et al*., 2008)**, and lettuce **(Coria-Cayupán *et al*., 2009)** and Chinese cabbage **(Wang *et al*., 2010)**. Additionally, the creation expenses of natural nutritive arrangements are lower contrasted with those of customary inorganic fertilizer solutions **(Wrzodak *et al*., 2012).**

Leachate is produced due to the microorganism activities that are present in the vermicomposting process. Draining the leachate that is produced can prevent vermicomposting unit saturation. Regardless of that, leachate that is derived from it is said to contain high plant nutrients and can be beneficial when used as liquid fertilizer **(Tejada *et al*., 2008)**.

The aims of the investigation were to evaluate the potential of different fertilization for eggplant production, and substrate volume to examine the effects on yield and fruit quality of eggplant under urban conditions.

MATERIAL AND METHODS

The study was carried out in the experimental station of Central Laboratory for Agricultural Climate (CLAC), Agriculture Research Center (ARC), Egypt, during summer seasons of 2019 and 2020. In order to achieve this aim the eggplants were studied in one substrate culture, with three fertilizer source mineral fertilizer, nutrient solution and organic fertilizers (vermi-liquid) combined with two pot volume 6 and 8 Liters in substrate culture.

Plant material:

Eggplant seeds (*Solanum melongena* L.) cV. Soma F1 Hybrid were sown in 1:1 (v/v) peat: vermiculite in polystyrene trays on 15th and 17th February of 2019 and 2020 respectively. After the fifth true leaf stage, the eggplant seedlings were transplanted 26 and 29 March of 2019 and 2020 respectively in different pot volume. Each plastic black pot (6 and 8 liter volume) was planted by one seedling. The pots placed in triple rows / table. The final plant spacing was 40 cm in the row, 40 cm among the rows.

The vermicomposting process:

The vermi-liquid offered via vermiculture and vermicomposting research unit, CLAC. Vertical indoor fattening trays was used to vermicomposting different organic urban wastes. Plastic boxes (64 boxes) arranged in four stands (4 shelves/ stand)) while a plastic tank laid in the bottom to collect the vermi-liquid during the vermicomposting process.

Each plastic box had 250 g of epigic earthworm (*Lumbriscus Rubellus* (Red Worm), *Eisenia Fetida* (Tiger Worm), *Perionyx Excavatus* (Indian Blue) and *Eudrilus Eugeniae* (African Night Crawler). The vermicomposting process, the different raw organic materials (kitchen wastes) shredded, mixed well and adjusted to the moisture level of 50 – 60 % (vegetables and fruits wastes, shredded paper and egg shells) before feeding earthworm. The composition of the different organic wastes is presented in **Table (1).** The vermi-liquid was collected weakly according to the vermicomposting process. The vermi-liquid was filtered by using nets to remove any residues or dust that could cause blocking of drippers before diluted to the desire EC regarding to **Abul-Soud and Mancey (2015)**.

Table (1): The chemical composition (%) of the different agricultural wastes.

Raw material	C/N ratio	Macro elements %				
		N	P	k	Ca	Mg
Kitchen wastes	50.23	0.59	0.44	0.56	0.98	0.62
Shredded paper	169.01	0.017	0.01	0.00	0.19	0.01
The mix	76.50	0.54	0.38	0.49	0.73	0.55

System materials

Close substrate system was carried on aluminum tables (1 x 2 x 0.6 m). Eighteen tables were used, each table supported with drainage system connected with separated tank to presented close substrate system. Vertical black plastic pots 6 and 8 liters volume were filled with substrate mixtures contained perlite and peat moss (1:1 v/v). The different plastic pots (volume 6 and 8 liters) were arranged in 3 rows to performed 18 plants for each table. The distance between each two plants was 0.4 m. Each table was representing one replicate.

The systems located in slope 1 % and 60 cm height to offer collecting the drainage in close system (nutrient solution, vermi-liquid and mineral fertilizer).

Mineral fertilizer (control) was added by standard recommendation of commercial growers. **(Agricultural technical bulletins, 2007).** The mineral fertilizer program add by g/m^3 water were illustrated in **Table (2**).

Table (2): The source of mineral fertilizer were diluted weekly for fertigation the eggplant with modify the water level in case of needed.

	Month				
Fertilizer (g/m^3)	**April**	**May**	**June**	**July**	**August**
Ammonium nitrate	**500**	**600**	**600**	**400**	**300**
Phosphoric acid	**150**	**250**	**250**	**200**	**150**
potassium sulphate	**400**	**500**	**300**	**400**	**500**
magnesium sulphate	**75**	**125**	**125**	**75**	**25**
Calcium nitrate	**100**	**250**	**450**	**450**	**0**

Eighteen tanks (wood tank) were established (one tank per each experimental plot) under the base of the system. Wooden frame surrounded black polyethylene (1mm) to create a tank (40 x 50 x 50 cm 100 L). Plants were irrigated by using drippers of 4 l/hr capacity.

Chemical nutrient solution, vermi-liquid and mineral fertilizer were pumped via submersible pump (80 watt). The fertigation was programmed to work 2 - 4 times / day while the duration and number of irrigation depended upon the season condition. The EC of the different fertilizer source were adjusted by using EC meter to the required level (2 – 3 ds/m^{-1}) during the different stages of eggplant growth. The chemical composition of vermi-liquid and chemical nutrient solution at EC level 2.5 ds/m^{-1} is illustrated in **Table (3**).

Table (3): The chemical composition of different source of nutrient solutions.

Element	Nutrient solution	Vermi liquid
Macro elements (ppm)		
N	250	128
P	45	181
K	350	322
Ca	180	111
Mg	50	48.6
Micro elements (ppm)		
Fe	3.0	0.25
Mn	1	0.04
Zn	0.06	0.01
Cu	0.10	0.04
B	0.25	0.21
Mo	0.014	n.d

***n.d Not determined**

The investigated treatments

The study investigated the effect of two factors (fertilization source and pot volume on the eggplant production as follows:

1. Fertilization source:

1. Chemical nutrient solution
2. Commercial mineral fertilizers
3. Vermi-liquid

2. Pot volume:

1. Pot volume 6 L
2. Pot volume 8 L

The experimental design was split plot with 3 replicates where fertilizing source were assigned as main plots and pot volume allocated as subplots.

The measurements

The following measurements were performed for three labeled-plants per replicate for each treatment at the end of growing season. Plant height (cm) was measured as distance from the level of upper side of growing pot to the highest point of plant stem fortnightly at the end of every season. Number of leaves per plant was determined by counting the leaves at the end of every season. Fresh and dry weight per plant were measured. Total chlorophyll content was determined by using chlorophyll meter (spod). Total fruit weight and number of total were measured fruit were calculated by the summation of all the fruit pickings per plant during the season. Fruit diameter (cm) was measured by a digital compass and fruit length (cm) was measured by the steel tape measure. Average of fruit weight (g) was calculated by marketable fruits weight divided to total number of the fruits.

For fruit dry matter percentage, N, P and K contents, three samples of fresh eggplant fruit per each treatment (500 g / sample) were dried in air-force oven at 70 ºC till constant weight was reached. Then dry matter percentage was calculated. Total nitrogen was determined by Kjeldahl method according to the procedure described by **FAO (1980).** Phosphorus content was determined using spectrophotometer according to **Watanabe and Olsen (1965).** Potassium content was determined photometrically using Flame photometer as described by **Chapman and Pratt (1961).**

The statistical analysis:

Analysis of the data was done by computer, using SAS program for statistical analysis and the differences among means for all traits were tested for significance at 5 % level **(Snedicor and Cochran 1981).**

All the other agricultural practices of eggplant cultivation were in accordance with the standard recommendations for commercial growers by Agriculture Research Center (ARC), Ministry of Agriculture, Egypt.

RESULTS AND DISCUSSION

Effect of fertilization source and pot volume on vegetative growth characteristics of eggplant

The impact of fertilization source and pot volume on vegetative growth characteristics of eggplant is presented in **Table (4)**. Data showed that the nutrient solution recorded the highest plant height, number of leaves, fresh and dry weight significantly compared to the rest fertilization treatments. There was no significant difference between the nutrient solution and mineral fertilizer on total chlorophyll content compared to vermi-liquid. The lowest vegetative growth characteristics were obtained by vermi-liquid in both studied seasons. **Abo Sedera *et al*., (2015), Abul-Soud *et al*., (2019) and Karla *et al*., (2020)** reported that the chemical nutrient solution gave the highest yield of melon, lettuce, celery and cucumber compared to vermi-liquid or vermicompost-tea as a logic result referring to the balance and sufficient nutrients composition of chemical nutrient solution that satisfying the plants nutrient requirements. The commercial mineral fertilizers designed mainly for soil application as well as offering the satisfied eggplant nutrient requirements but mineral fertilizers didn't match the substrate culture conditions and needs.

Table (4): Effect of fertilization source and pot volume on vegetative characteristics of eggplant at harvest time during 2019 and 2020 season

Pot volume	First season				Second season			
	fertilization sources				fertilization sources			
	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean
Plant height (cm)								
Volum6	58.4 c	55.5 c	45.9 e	53.3 B	57.1 b	52.3 c	42.6 e	50.7 B
Volum8	74.2 a	61.8 b	50.9 d	62.3 A	70.0 a	58.3 b	48.0 d	58.8 A
Mean	66.3 A	58.6 B	48.4 C		63.5 A	55.3 B	45.3 C	
Number of leaves/ plant								
Volum6	113.1 b	100.1 c	53.2 e	88.8 B	107.6 b	95.0 c	50.6 e	84.5 B
Volum8	129.3 a	111.03 b	62.9 d	101.2 A	122.0 a	105.0 b	59.3 d	95.4 A
Mean	121.2 A	105.7 B	58.0 C		114.8 A	100.2 B	55.0 C	
Fresh weight per plant / g								
Volum6	196.4 c	192.3 c	139.3 d	176 B	190.1 b	176.2 c	133.4 e	166.6 B
Volum8	233 a	214.7 b	145.6 d	197.8 A	225.5 a	219 a	152.5 d	198.8 A
Mean	214.7 A	203.5 A	142.5 B		207.8 A	197.6 B	142.9 C	
Dry weight per plant / g								
Volum6	30.3 c	31.4 c	21.5 e	27.8 B	31.5 b	29.4 c	22.8 e	27.9 B
Volum8	40.6 a	36.3 b	26.8 d	34.7 A	38.4 a	37.2 a	28.6 d	34.7 A
Mean	35.45 A	33.85 A	24.15 B		34.95 A	33.3 A	25.7 B	
Total chlorophyll reading (Spad)								
Volum6	56.5 a	56.7 a	48.6 b	53.9 B	54.5 ab	52.6 b	45.9 c	50.9 B
Volum8	57.4 a	58.2 a	50.6 b	55.4 A	55.0 ab	55.1 a	47.7 c	52.6 A
Mean	56.9 A	57.4 A	49.6 B		54.7 A	53.7 A	46.8 B	

*** Similar letters indicate non-significant at 0.05 levels.**

**** Capital letters indicate the significant difference of each factor (P<0.05)**

Regarding the effect of pot volume on eggplant vegetative growth, the obtained results showed that increasing the pot volume from 6 to 8 liter prompted increment the plant height, number of leaves, fresh & dry weight and total chlorophyll content during the two tried seasons. Increase the pot / substrate volume offer more comfortable condition for root growth and allow the plants to have better nutrient uptake, adequate development and improvement to enhance water and oxygen holding **(Verdonck *et al.,* 1982, Albaho *et al.,* 2009 and Abul-Soud 2015)**.

The effect of the interaction between fertilization source and pot volume is shown **(Table 4),** data showed that nutrient solution combined with pot volume 8 L. gave the highest plant height, number of leaves, fresh and dry weight followed by mineral fertilizer with pot volume 8 L. On the other hand, the lowest vegetative growth characters were obtained by using vermi-liquid with pot volume 6 L during the both two cultivated seasons. These results agree with **Abul-Soud (2015)** that referenced the pot volume had a critical beneficial outcome on the growth and yield of the leafy vegetables under the study, while this effect was not significant on N, P and k contents of celery, lettuce, salad and red cabbage plants.

Effect of fertilization source and pot volume on yield parameters of eggplant

Table (5) illustrated the effect of pot volume and fertilization source on eggplant yield. The revealed data indicated that using nutrient solution increased total yield / plant, total yield / m^2, average fruit weight, fruit length and fruit diameter significantly, followed by mineral fertilizer. There was no significant difference between nutrient solution and mineral fertilizer on fruit length in both season. The lowest data obtained with vemi- liquid treatments. These results matched with the vegetative growth characteristics.

Table (5) also showed the effect of pot volume on fruits characteristics of eggplant, the highest fruit fresh weight, number of fruit, fruit length and fruit diameter was obtained by pot volume 8 L compared to pot volume 6 L. These results also matched with the vegetative growth characteristics.

Regarding the effect of the interaction between fertilization source and pot volume, data showed that nutrient solution with pot volume 8 L gave the highest total yield / plant, total yield / m^2, average fruit weight, fruit length and fruit diameter followed by mineral fertilizer with pot volume 8 L. On the other hand, the lowest fruits characters and yield were obtained by using vermi-liquid with pot volume 6 L during the two tested seasons. The most minimal yield, weight and size of natural produce contrasted with inorganically delivered eggplant could be credited to the low supplement convergence of natural compost arrangements **(Márquez *et al*., 2014)**, too to the imbalanced supplement proportion in the vermi-liquid provided. Low supplement focus in natural arrangements came about because of the arrangements weakening so as to keep away from phytotoxicity in plants **(Gutiérrez *et al*., 2008).** In addition,

Preciado *et al*. (2011) and Márquez *et al*. (2014) announced that the low supplement focus as well as the imbalanced supplement proportion in the supplement arrangements influence the typical plant development; in this way consistently bring about a lower size and weight of natural products. Consequently, in the current investigation the lower natural product weight and size in eggplant created under the organic treatments could have been generally brought about by a nitrogen deficiency since it is realized that a deficient nitrogen flexibly during crop development and advancement influences adversely vegetable and natural product yield, size and weight **(Sainju *et al*., 2003; Jasso-Chavarria *et al*., 2005 and Rodriguez *et al*., 2005).**

Table (5): Effect of fertilization source and pot volume on yield parameters of eggplant at harvest time during 2019 and 2020 season

Pot volume	First season				Second season			
	fertilization sources				fertilization sources			
	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean
Yield (Kg/plant)								
Volum6	2.7 b	2.4 c	1.8 e	2.3 B	3.1 b	2.6 c	1.5 e	2.4 B
Volum8	3.6 a	2.9 b	2.1 d	2.86 A	3.8 a	3.3 b	2.4 d	3.16 A
Mean	3.15 A	2.65 B	1.95 C		3.45 A	2.95 B	1.95 C	
Total yield (kg /m^2)								
Volum6	24.3 b	21.6 c	16.2 d	20.7 B	27.9 b	23.4 c	13.5 e	21.6 B
Volum8	32.4 a	26.1 b	18.9 d	25.8 A	34.2 a	29.7 b	21.6 d	28.5 A
Mean	28.35 A	23.85 B	17.55 C		31.05 A	26.55 B	17.55 C	
Average Fruit weight (g)								
Volum6	60.2 b	53.2 c	41.9 d	51.7 B	56.8 b	50.2 c	39.6 d	48.8 B
Volum8	67.2 a	55.9 bc	44.8 d	55.9 A	63.4 a	52.7 bc	42.3 d	52.8 A
Mean	63.6 A	54.5 B	43.4 C		60.1 A	51.5 B	40.9 C	
Fruit length (cm)								
Volum6	12.1 b	11.9 b	7.8 c	10.6 B	11.7 b	11.8 ab	7.5 c	10.3 B
Volum8	13.4 a	12.8 ab	8.9 c	11.7 A	12.9 a	12.3 ab	8.6 c	11.3 A
Mean	12.7 A	12.3 A	8.4 B		12.3 A	12.1 A	8.0 B	
Fruit diameter (cm)								
Volum6	3.2 b	3.0 cd	2.8 d	2.9 B	3.1 ab	2.8 cd	2.6 d	2.9 B
Volum8	3.4 a	3.1 bc	3.0 cd	3.1 A	3.2 a	2.9 bc	2.8 cd	3.0 A
Mean	3.3 A	3.0 B	2.9 C		3.2 A	2.9 B	2.8 B	

*** Similar letters indicate non-significant at 0.05 levels.**

**** Capital letters indicate the significant difference of each factor ($P<0.05$)**

Effect of fertilization source and pot volume on mineral contents of eggplant

The effect of fertilization source on N, P and K percentage is presented in **Table (6)**. The revealed results indicated that using mineral fertilizer gave the highest N percentage followed by nutrient solution but, there was no significant difference between the effect of nutrient solution and mineral fertilizer on P and K percentages during both cultivated seasons. The lowest N, P, and K percentage presented by vermi-liquid treatment was observed.

Referring to the effect of pot volume on N, P and K content, data in Table (6) showed that using pot volume 8 liter led to the increase of N, P and K % significantly compared to pot volume 6 liter. These results can be explained according to the larger volume of the substrate culture that serves to retain the larger amount of nutrients higher than the smaller volume of the substrate culture. This results agree with **Abul-Soud (2015) and Abul-Soud *et al* (2019)**.

Concerning the interaction effect between fertilization sources and pot volume, the pot volume 8 L with nutrient solution and mineral fertilizer gave the highest N, P, and K percentage and there were no significant differences between them.

Organic inputs alone will not meet the nutritional needs of crops because they contain a comparatively less quantity of nutrients compared to inorganic fertilizers, the need to integrate the two forms in order to achieve better crop yields. The interaction between organic matter and inorganic fertilizers may lead to either an increase or decrease in nutrients in soil depending on the nutrient and plant material in question (**Frankenberger and Abdelmagid 1985).**

Table (6): Effect of fertilization sources and pot volume on nutrient content (N, P and K %) of eggplant at harvest time during 2019 and 2020 season

Pot volume	First season				Second season			
	fertilization source				fertilization source			
	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean	Nutrient Solution	Mineral Fertilizer	Vermi-Liquid	Mean
N (%)								
Volum6	3.09 c	3.26 b	2.26 e	2.87 B	3.12 c	3.27 b	2.28 e	2.89 B
Volum8	3.43 a	3.40 a	2.49 d	3.11 A	3.46 a	3.44 a	2.52 d	3.14 A
Mean	3.26 B	3.33 A	2.37 C		3.29 B	3.36 A	2.40 C	
P (%)								
Volum6	0.51 ab	0.50 b	0.37 c	0.44 B	0.54 a	0.53 a	0.39 d	0.47 B
Volum8	0.54 a	0.54 a	0.30 d	0.48 A	0.55 a	0.57 a	0.33 c	0.50 A
Mean	0.53 A	0.52 A	0.34 B		0.54 A	0.55 A	0.36 B	
K (%)								
Volum6	2.40 b	2.49 b	2.09 c	2.33 B	2.47 c	2.55 b	2.17 c	2.40 B
Volum8	2.60 a	2.63 a	2.15 c	2.46 A	2.73 a	2.68 a	2.21 c	2.54 A
Mean	2.50 A	2.56 A	2.12 B		2.60 A	2.61 A	2.19 B	

*** Similar letters indicate non-significant at 0.05 levels.**
**** Capital letters indicate the significant difference of each factor ($P<0.05$)**

Effect of top-roof garden on the roof temperature in urban agriculture

The impact of top-roof garden is not just limited by food production and security but also expend to mitigate the climate change impacts on urban and rural regions. The results of **Table (7)** supported strongly the implementation of top-roof garden on roof temperature. The ambient temperature of bare roof area recorded higher temperature that cultivated roof area. The use of top-roof garden system reduces the temperature on the roof via shading the roof and protected the roof from the extreme weather events exposure, these results are very important for creating the resilliance city that have the capability to mitigate and adapted climate change impacts while offered the sustainable food production and minimize the energy consumption. The reduction of top-roof impact was in a range from 3 to 4 ^{o}C. This range is very significant during the hot summer days.

Table (7): The effect of urban horticulture system on maximum temperature during 2019 and 2020 season.

First season 2019				Second season 2020			
Date	RH (%)	Amb. Temp, ^{o}C	Und. Temp, ^{o}C	Date	RH (%)	Amb. Temp, ^{o}C	Und. Temp, ^{o}C
1-7/3/2019	57.53	21.00	18.26	1-7/3/2020	48.70	24.82	21.42
8-14/3/2019	49.32	24.65	21.67	8-14/3/2020	61.24	25.57	22.23
15-21/3/2019	52.93	24.70	20.04	15-21/3/2020	57.06	22.06	19.04
22-31/3/2019	47.26	25.01	21.93	22-31/3/2020	50.85	26.26	23.30
1-7/4/2019	47.51	25.94	21.36	1-7/4/2020	50.31	27.27	24.31
8-14/4/2019	41.18	29.54	26.00	8-14/4/2020	55.37	24.57	21.19
15-21/4/2019	50.05	24.61	21.25	15-21/4/2020	48.65	29.55	26.55
22-30/4/2019	36.20	30.76	26.46	22-30/4/2020	58.83	27.46	24.83
1-7/5/2019	32.97	34.06	31.22	1-7/5/2020	53.96	29.19	26.63
8-14/5/2019	31.34	33.51	30.76	8-14/5/2020	48.90	32.14	29.34
15-21/5/2019	24.83	38.26	34.32	15-21/5/2020	39.66	39.92	36.12
22-31/5/2019	32.03	38.43	34.85	22-31/5/2020	44.34	31.29	28.15
1-7/6/2019	36.41	38.41	35.33	1-7/6/2020	39.45	35.54	32.24
8-14/6/2019	39.45	36.44	33.60	8-14/6/2020	34.40	36.89	33.56
15-21/6/2019	36.41	38.16	35.97	15-21/6/2020	35.46	38.05	35.75
22-30/6/2019	38.20	39.94	35.28	22-30/6/2020	38.85	37.90	34.37
1-7/7/2019	36.81	39.12	36.95	1-7/7/2020	32.15	40.08	36.41
8-14/7/2019	37.83	40.10	36.16	8-14/7/2020	41.91	38.49	34.28
15-21/7/2019	38.81	38.99	35.50	15-21/7/2020	41.40	38.41	35.92
22-31/7/2019	41.99	38.51	34.80	22-31/7/2020	39.85	39.77	35.68
1-7/8/2019	42.36	39.22	35.94	1-7/8/2020	37.55	40.32	36.70
8-14/8/2019	33.46	39.19	35.74	8-14/8/2020	44.65	38.97	34.99
15-21/8/2019	39.96	39.07	35.10	15-21/8/2020	41.76	39.16	35.68
22-31/8/2019	41.73	38.64	35.31	22-31/8/2020	41.66	38.82	35.72
1-7/9/2019	43.64	37.53	34.89	1-7/9/2020	42.68	40.48	36.62
8-14/9/2019	48.65	35.91	31.83	8-14/9/2020	46.03	38.52	34.30
15-21/9/2019	48.75	35.65	32.42	15-21/9/2020	45.07	38.63	35.79
22-30/9/2019	48.15	35.26	31.11	22-30/9/2020	48.54	36.95	32.55

Amb. Temp. = Ambient Temperature.
Und. Temperature = under urban horticulture system temperature
RH = relative humidity

The economic impact assessment

The revealed data of **Table (8)** indicated that the environmental action via vermicomposting that used as a successful strategy for recycling organic urban wastes into vermicompost and vermin-liquid had an economic value beside achieve the sustainable objectives. Nutrient solution as a source of fertilizer gave the highest yield but also recorded the highest cost that resulted strongly on its economic use led to present the highest net profit. The commercial chemical fertilizers also gave similar results but with cost reduction that enhance the net profit eventually to be better than nutrient solution.

On the other hand, vermi-liquid as an operation cost equal 99 referring to seedling, electricity and pesticide, however, it also achieves little profit when used in urban horticulture.

As a matter of fact, increasing pot volume from 6 liters to 8 liters led to increase the investment cost and operation depending on used substrate volume and the difference of pot cost. Moreover, this increase in pot volume had a significant positive impact on the yield that led to increase return and net profit.

The real results of economic assessment under this investigation could be summarized under "Environmental action in the service of the economy and society".

Table 8. The economic impact of eggplant under different fertilizer source and pot volume.

Fertilizer source	Pot volume	Average cost and profitable impact (6 m^2)						
		Investment costs	Operation cost	Total cost	Average yield / Kg	Price EGP	Return EGP	Net profit EGP
N. S	8 L	294.00	463	757.00	194.4	5	972	215.0
N. S	6 L	230.00	463	693.00	145.8	5	729	36.0
Ch. R	8 L	294.00	204	498.00	156.6	5	783	285.0
Ch. R	6 L	230.00	204	434.00	129.6	5	648	214.0
V. L	8 L	294.00	99	393.00	113.4	5	567	174.0
V. L	6 L	230.00	99	329.00	97.2	5	486	157.0

***Price EGP (Egyptian pound) calculated based on the average commercial (farm) price during the seasons of eggplant; ** N.S (nutrient solution); ***Ch. R (chemical recommendation); ****V. L (vermin liquid).**

CONCLUSIONS

The results of the present study indicated that using substrate culture with nutrient solution or mineral fertilize lead to the increase of plant growth and final yield. Plants fertilized with organic fertilizer showed lower total yield in comparison with nutrient solution and mineral fertilized. The highest N, P and K percentage were obtained in the case of plants grown in pots volume 8 L with nutrient solution and mineral fertilizer.

The study recommended for commercial application that achieve the highest yield using recommended chemical fertilizers followed by chemical nutrient solution (that more available in the market) combined with pot volume 8 L on the scale of small to medium urban farm. While for sustainable urban agriculture condition (the main target of the current study) implement vermi-liquid as fertilization source combined with pot volume 8 L to gained sustainable and economic eggplant yield on the scale of micro to small urban farm due to the availability of producing vermin-liquid in a subjective manner.

There is a lot of research that should be studied by professionals in the field of energy use efficiency and the impact of top-roof garden in urban on the heat urban island as well as mitigate and adapt the climate change impacts and CO_2 emission.

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إنتاج الباذنجان بإستخدام الزراعه الحضريه المستدامه

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لإنشاء مدينة قادرة على الصمود في ظل تأثيرات تغير المناخ ، فإن الإستراتيجية الأكثر نجاحًا هي الزراعة الحضرية. أصبحت الحاجة إلى تلبية الأمن الغذائي والسلامة وإمكانية الوصول أمرًا ملحًا في ظل وباء كوفيد 19.

ثلاثة مصادر تسميد (محلول مغذي ، سماد معدني ، سائل دودي) مع وعائين بحجم 6 و 8 لترات من البيتموس : البيرليت (50:50) تم تقييمها على محصول الباذنجان خلال موسمين صيفيين متتاليين لعام 2019 و 2020 في المعمل المركزي للمناخ الزراعي ، مركز البحوث الزراعية ، الدقي ، محافظة الجيزة. هدفت الدراسة إلى فحص إنتاج الباذنجان من حيث (المحصول والجودة) في ظل الظروف الحضرية. تم حساب عدد الثمار الكلية لكل نبات بإنتظام خلال فترة الحصاد. تم حساب العدد الإجمالي للأوراق خلال فترة الحصاد الخضري. تم قياس قطر الثمرة (سم) وطول الثمرة (سم). تم حساب متوسط وزن الثمار (جم) على أساس وزن الثمار القابلة للتسويق مقسومًا على العدد الإجمالي للثمار ، كما تم تقدير محتوى أوراق نبات الباذنجان من النتروجين والفوسفور والبوتاسيوم بجانب تحديد الإستخدام الإقتصادي.

أشارت النتائج المتحصل عليها إلى أن الكميات والتوازن بين العناصر الغذائية الأساسية المختلفة أدى إلى تعزيز النمو الخضري ومحصول الباذنجان مقارنة بمصادر الأسمدة الأخرى. سجل محلول المغذي الكيميائي أعلى معدل نمو خضري وخصائص إنتاجية للباذنجان بينما سجل المحلول السائل الدودي أقل النتائج. بينما يزيد المحلول المغذي والأسمدة المعدنية محتويات الباذنجان من النتروجين والفوسفور والبوتاسيوم مقارنة بإستخدام محلول السائل الدودي. أدت زيادة حجم الوعاء من 6 إلى 8 لتر من الركيزة إلى زيادة النمو الخضري وخصائص إنتاجية الباذنجان كما زاد محتوى أوراق الباذنجان من النيتروجين والفوسفور والبوتاسيوم. تم إعطاء أعلى نسبة نمو خضري وخصائص إنتاجية للباذنجان عن طريق محلول مغذي كيميائي مدمج مع أحجام الأصص 8 لتر كما سجل المحلول الكيميائي المغذي مع أحجام الأصص 8 لتر أعلى محتوى من N ، P ، K ٪ .

أدى إستخدام محلول السائل الدودي كمصدر للأسمدة وحجم وعاء 6 لتر إلى تأثيرات مستدامة واقتصادية للبستنة الحضرية في ظل تأثيرات تغير المناخ ولضمان الأمن الغذائي في ظل وباء كوفيد 19.