Effect of Using Different Percentages of Vermicompost on the Growth and Production of Eggplant (Solanum Melongena L.) Grown In Different Sizes of Pots under Greenhouses

Hussein Saheer Hassan[1], Kutaiba Yuser Aied[2]
[1]College of Agriculture-Tikrit University–Iraq
[2]Ministry of Higher Education and Scientific Research–Iraq
Hussen.saheer.iq@gmail.com

Abstract

The experiment was carried out in the greenhouse complex of the Department of Horticulture and Landscaping-Agriculture College-Tikrit University for the agricultural season 2022-2021 to study the use of different percentages of Vermicompost fertilizer (P1 = 5%, P2 = 10%, P3 = 15%) added to the cultivation medium in pots in addition to comparison treatment P0 (without addition), The second factor is three volumes of pots (8 liters = V1, 16 liters = V2, and 24 liters = V3) and the interaction between them according to the randomized complete blocks design (RCBD) with a split-plot design with three replications.

The results showed an increase in the growth and yield of eggplant with an increase in the proportions of fertilizer addition and an increase in the size of the pots, as the two treatments of adding organic fertilizer by 15% (P3) as well as the size of the large pot (V3) gave a significant superiority in most of the studied traits, as they gave 702.56 g plant-1 and 1.64 kg plant-1 for vegetative growth weight and total yield, respectively, compared to the control treatment (410 g and 0.75 kg plant-1, respectively), Also, the large pot size (V3) gave the highest increase rate of 33.35%, 105.67% and 116% for the characteristics of the vegetative and root growth weight and the total yield compared to the small size (V1). As for the interaction treatments, the interaction P3V3 gave the highest total yield of 2.43 kg plant-1 compared to 0.57 kg plant-1 for the control treatment (V1P0).

Keywords: eggplant, pots, Vermicast -worm manure-, greenhouse.

1. Introduction

Eggplant (*Solanum melongena* L.) is an economically important summer vegetable crop that belongs to the family Solanaceae [1] and its original home is India and China. Its cultivation has spread in Spain, Africa and other parts of the world. The Europeans introduced it to America, as its purple and white cultivars were planted as ornamentals [2].

The fruits of eggplant are characterized by a good content of vitamins A, B1, B2, B5, C in addition to their medicinal benefits. Eggplant is beneficial for health, especially in the treatment and prevention of atherosclerosis and contributes to the prevention and removal of obesity because it has a reduced calorie content, and impedes the transmission of cholesterol from the stomach to the arteries and contributes to reducing fat, eggplant also contains a high percentage of anti-cancer substances [3].

The increase in the rates of chemical fertilizers used when growing vegetable crops compared to other crops due to the possibility of planting them in more than one season per year led to the aggravation and increase of the harmful effects on health and the environment, especially the residual effect of nitrates, which is one of the compounds most dangerous to human health [4]. As a result of these bad effects, attention has turned in many countries of the world to encourage the use of organic sources in fertilizing instead of chemical fertilizers. One of these alternatives is Vermicompost worm fertilizer, which is an organic fertilizer rich in nitrogen, phosphorous, potassium, micro-nutrients and beneficial soil microbes (dissolved nitrogen and phosphate-fixing bacteria). It is a sustainable alternative to chemical fertilizers and is an excellent growth stimulator for crop plants. [5, 6].

In order to reduce production costs under greenhouses, it is necessary to reduce labor wages resulting from soil sterilization, plowing, smoothing, leveling and jungle control operations, as this is done through planting in containers or pots, often container farming is a good option for home gardens, Containerized planting also allows for better drainage in areas with poor surface drainage or near the surface, can help make cultivating bushes and weeds easier, it can help make gardening easier for the farmer.

Based on the foregoing, the research objective is to improve eggplant production in quantity and quality by using Vermicompost organic fertilizer and to determine the best addition ratios when planted under greenhouses instead of using chemical fertilizers determining the best pot size for growing eggplant with different fertilizer concentrations and reducing production costs within protected agriculture by determining the smallest size suitable for eggplant production in plastic containers, and thus reducing the amount of fertilizer and food medium added.

2. Materials and Methods

The experiment was carried out during the agricultural season 2022-2021 AD in the greenhouse complex of the Department of Horticulture and Garden / College of Agriculture / Tikrit University / in a greenhouse 45 m long and 9 m wide. The experiment site has been prepared

doi.org/10.31838/hiv22.02.200 Received: 09.05.22, Revised: 08.05.22, Accepted: 08.08.22

inside the greenhouse, where the plants will be grown inside plastic pots of different sizes and with different rates of organic fertilization. Therefore, the experiment ground was modified leveled, and then completely covered with a plastic cover before placing the anvils on it, to prevent moisture and roots from infiltrating the anvils into the soil beneath, as well as to help prevent bush growth, a sample of the cultivation soil was taken before adding the fertilizer and analyzing it, and the results of the analysis were as in Table (1)

Table (1) Physical and chemical properties of soil without adding Vermicompost

value	Unit	trait
4.6	millimose	EC 1:1
7.4		PH 1:1
1610	Mg.L-1	TDS 1:1
1.1	%	O.M
17	%	CaCO3
4	%	CaSO4
46.1	%	Sand
34.2	%	silt
19.7	%	Clay
Loam		Soil Texture

The seeds were planted on 1/10/2021 in cork dishes with a capacity of 209 plants (a hybrid of Barcelona eggplant, produced by the Spanish company Fito), which is one of the hybrids used in protected cultivation under the conditions of the central region of Iraq in non-air-conditioned greenhouses and after 45 days From planting seeds, the seedlings are ready for planting in the permanent place (the containers), where one seedling contains 4-5 leaves. The plants were transplanted on 15/11/2021 in the pots after watering the pots a day before the planting date, then a special program was developed for agricultural service operations (watering, digging the bushes, flipping the soil on the surface of the containers, and ventilating the greenhouse to reduce humidity). The experiment was designed using a randomized complete block design (RCBD) with a split-plot design . The experiment included two factors: the first factor; Adding percentages of Vermicompost fertilizer with three percentage additions (5% = P1, 10% = P2, 15% = P3) in addition to the control treatment P0 where samples were taken from the soil after mixing and the major elements were analyzed as in Table 2., The second factor is three sizes of pots (8 liters = V1, 16 liters = V2, and 24 liters = V3), where the pots took the main pieces, while the addition ratio took the secondary and most important pieces. Plants were planted in pots at a distance of 50 cm between them alternately. Measurements were taken from 5 plants for each experimental unit to study the following characteristics: area of one leaf ($cm^2 leaf^{-1}$), total chlorophyll content in leaves (mg. g^{-1}) according to the method [7], vegetative growth weight (g $plant^{-1}$), fresh weight of rootstock (g $plant^{-1}$), total yield per plant (kg $plant^{-1}$), The total number of fruits per plant (fruit. plant-1), the average weight of the fruit (grams), the percentage of protein in the fruits (%) according to the semi-micro kjeldal method, the percentage of carbohydrates in the fruits (%) according to the method (Joslyn, 1970). Then the results were analyzed according to the SAS program and the averages were compared according to Duncan's Multiple Range Test at a probability level of 0.05.

Table (2) Analysis of the major elements of soil in the pot after adding Vermicompost fertilizer

The proportions of adding fertilizer to the medium				Element Status	Unit	Element
15%	10%	5%	0 %			
25.2	22.6	16.4	9.7	melted	mg.kg-1	N
61.6	46.7	35.1	27.4	ready		
18.2	13.1	10.8	5.3	melted		P
34.5	29.4	16.3	10.8	ready		
33.4	25.5	26.2	15.5	melted		K
204	192.3	157	112.4	ready		

3. Results and Discussion

1.Effect of Vermicompost Fertilizer

It is noticed from the results of Table (3) that there is a significant effect of the fertilization rates with Vermicompost fertilizer on most of the traits (area of one leaf, chlorophyll content of leaves, vegetative growth weight, fresh weight of the root system, total yield, number of fruits, average fruit weight, protein in fruits, carbohydrates in fruits).

Where the percentage of addition was 15% (P3) (the highest rates for the studied traits amounted to) 205.222 cm^2 $plant^{-1}$, 75.29 mg gm^{-1}, 702.56 g. $plant^{-1}$, 365.33 g. $plant^{-1}$, 1.64 kg. $Plant^{-1}$, 12.22 fruits. $Plant^{-1}$, 199.63 g, 9.42%, 54.22%) respectively, followed by the addition percentage of 10% (P2) with a clear superiority to the control treatment (P0)), which gave the lowest rates (116.556 cm^2.$Plant^{-1}$, 75.29 mg g^{-1}, 465.22 g plant, 200.11 g plant, 0.82 kg. plant, 7.86 fruits. plant, 139.19 g, 8.49%, 52.28%) respectively.

The reason for these results is attributed to the role of vermicompost in improving the physical and chemical properties of the soil and increasing the readiness of the nutrients necessary for the plant, which raises the concentration of these elements in the plant, which leads to an increase in the process of photosynthesis, thus increasing the construction of carbohydrates in the leaves and increasing vegetative growth, which is reflected positively on the quantity and quality of the yield [8].

These results agree with what Lim et al. [9] reported in an experiment on the use of vermicompost in organic farming and its effects on the soil that it improves porosity, aeration and water-holding capacity of the soil, lowers the pH as well as increases the availability of the necessary elements of the plant and organic matter and the beneficial microbial activity of the soil Which led to increased growth and productivity of the cultivated crops.

Table (3) Effect of adding different percentages of Vermicompost on the growth and yield of eggplant

%of carbohydrates in fruits	% protein in fruits	Average fruit weight (grams)	Number of fruits (fruit. plant)	Total yield (kg. plants)	Weight of the root system grams.plant	Vegetative growth weight grams.plant	Chlorophyll in leaves (mg/g)	Leaf area (cm2. Leaf-1)	Trait Fertilization ratios
52.28 d	8.49 d	139.19 d	7.86 d	0.82 d	200.11 d	465.22 d	64.55 d	116.556 d	المقارنة)P0(
53.28 c	8.79 c	160.63 c	9.89 c	1.12 c	262.33 c	586.11 c	70.19 c	145.556 c	5) %P1(
53.84 b	9.23 b	174.86 b	10.78 b	1.36 b	304.33 b	664.44 b	72.35 b	165.556 b	10%)P2(
54.22 a	9.42 a	199.63 a	12.22 a	1.64 a	365.33 a	702.56 a	75.29 a	205.222 a	% 15)P3(
* Similar letters show that there are no significant differences between the means according to Duncan's multiple range test, at a probability level of 5%.									

2

Effect of planting pot sizes

The results in Table (4) indicate a significant effect of planting pot sizes on the studied vegetative growth and yield traits of eggplant, where the pot size V3 recorded the best values for traits averaged at 177.167 cm^2. $Leaf^{-1}$, 72.98 $mg.gm^{-1}$, 684.50 g. $Plant^{-1}$, 392.67 g. $Plant^{-1}$, 1.71 kg. $Plant^{-1}$, 11.58 fruits. $Plant^{-1}$, 194.05 g, 9.24%, 53.92% for the characteristics of one leaf area, chlorophyll content of leaves, vegetative growth weight, fresh weight of the root system, total yield, number of fruits, average fruit weight, protein in fruits, carbohydrates in fruits, respectively. The pot size V2 gave good rates of growth and yield characteristics, superior to the small size V1, which gave the lowest rates of 130,083 cm^2. $Leaf^{-1}$, 68.27 mg gm^{-1}, 513.33 gm. plant, 190.92 gm. plant, 0.79 kg. plant, 8.75 fruits. plant, 148.69 gm, 8.62%, 52.78% for the above traits, respectively.

The reason for this may be due to the increased availability of nutrients necessary for plant growth, which is reflected in the quantity of flowers and the quality of the fruits due to the increase in the volume of the soil in the large pot and the related increase in the proportions of added fertilizers rich in major and minor elements.

These results agree with what Bres et al. [10] indicated that increasing the size of the planting pots made plants of the Solanaceae family better in growth and higher in yield with early yield, due to the total area of leaves and the wet weight of the shoot and root system.

It appears from the results of the same table that the rate of the studied vegetative and root trait increased when plants were grown inside large pots, the reason for this may be due to the formation of an appropriate root system and thus increases the efficiency of root absorption of nutrients and this was confirmed.

Table (4) Effect of planting pot sizes on the growth and yield of eggplant

%of carbohydrates in fruits	% protein in fruits	Average fruit weight (grams)	Number of fruits (fruit. plant)	Total yield (kg. plants)	Weight of the root system grams.plant	Vegetative growth weight grams.plant	Chlorophyll in leaves (mg/g)	Leaf area (cm^2. $Leaf^{-1}$)	Trait Pots volume
52.78 c	8.62 c	148.69 c	8.75 c	0.79 c	190.92 c	513.33 c	68.27 c	130.083 b	Small (V1)
53.53 b	9.09 b	162.99 b	10.25 b	1.22 b	265.50 b	615.92 b	70.54 b	167.417 a	Middle (V2)
53.92 a	9.24 a	194.05 a	11.58 a	1.71 a	392.67 a	684.50 a	72.98 a	177.167 a	Big (V3)
* Similar letters show that there are no significant differences between the means according to Duncan's multiple range test, at a probability level of 5%.									

3-

The effect of the interaction between the percentages of Vermicompost fertilizer and the sizes of the planting pots

The results in Table (5) showed that the interaction between the different fertilizer ratios and the pot size had a significant effect on the studied vegetative growth and yield characteristics, and the treatments varied in their effect. Whereas, the highest rates of traits recorded by treatment V3P3 were 245.67 cm2. Leaf-1, 77.74 mg gm-1, 788.33 g. Plant-1, 531.33 g, 2.43 kg. Plant-1, 13.67 fruits. Plant-1, 247.22 g, 9.87%, 55.30% for the traits of the area of one leaf, chlorophyll content of leaves, vegetative growth weight, fresh weight of the root system, total yield, number of fruits, average fruit weight, protein in fruits, carbohydrates in fruits, respectively, It was followed by treatment V3P2 with good rates for the studied traits, then treatment V2P3, followed by treatment V2P2, and thus it clearly outperformed treatment V1P0, which recorded the lowest rates of 107.00 cm^2. $leaf^{-1}$, 63.04 mg gm^{-1}, 410.00 g. plant, 148.33 gm. plant, 0.57 kg. plant, 7.33 fruits. plant, 132.67 gm, 8.43%, 52.13% for the above traits respectively.

The reason for this may be due to the increase in the efficiency of plants grown in large containers due to an increase in the amount of macro and micro nutrients necessary for the growth of plants in the proportions of fertilizer added with the soil of the pot which led to the production of plants with better specifications then the

plants grown in smaller containers, thus accelerating the growth of plants inside the greenhouse, these results in agreement with those of [11].

As the planting pots maintain the proportions of added fertilizers, therefore, they continue to supply the plants with the necessary nutrients to maintain the continuity of their growth and achieve quantitative and qualitative improvement of the yield. These added proportions of fertilizers are proportional to the size of the soil inside the pot. Thus, the increase in vegetative and root growth, which is positively reflected on the increase in yield, quality of fruits and their freedom from infections. These results are consistent with what Jassem et al. [12] mentioned.

Table (5): The effect of the interaction between the ratios of Vermicompost fertilizer and the pot size on the growth and yield of eggplant

%of carbohydrates in fruits	% protein in fruits	Average fruit weight (grams)	Number of fruits (fruit. plant)	Total yield (kg. plants)	Weight of the root system grams.plant	Vegetative growth weight grams.plant	Chlorophyll in leaves (mg/g)	Leaf area (cm2. Leaf-1)	Trait treatments	
52.13 h	8.43 f	132.67 i	7.33 g	0.57 j	148.33 h	410.00 j	63.04 g	107.00 i	P0	V1
52.67 f	8.53 f	144.17 gh	8.33 fg	0.74 i	190.00 g	488.33 h	67.96 de	121.67 hi	P1	
53.10 e	8.77 e	154.17 f	8.67 ef	0.88 g	207.00 fg	564.00 f	69.65 cd	132.67 gh	P2	
53.20 e	8.73 e	163.75 e	10.67 cd	0.97 f	218.33 f	591.00 e	72.45 b	159.00 def	P3	
52.30 gh	8.50 f	136.83 hi	8.00 fg	0.82 h	183.33 g	471.67 i	64.61 fg	106.33 i	P0	V2
53.63 d	8.87 de	153.72 f	9.67 de	1.09 e	249.67 e	582.67 e	70.22 bcd	164.33 cde	P1	
54.00 c	9.33 c	173.50 d	11.00 c	1.41 d	282.67 d	681.00 d	71.64 bc	188.00 bc	P2	
54.17 c	9.67 b	187.92 c	12.33 b	1.53 c	346.33 c	728.33 c	75.68 a	211.00 b	P3	
52.40 g	8.53 f	148.07 fg	8.33 fg	1.08 e	268.67 de	514.00 g	66.00 ef	136.33 fgh	P0	V3
53.53 d	8.97 d	184.00 c	11.67 bc	1.54 c	347.33 c	687.33 d	72.40 b	150.67 efg	P1	
54.43 b	9.60 b	196.92 b	12.67 ab	1.78 b	423.33 b	748.33 b	75.76 a	176.00 cd	P2	
55.30 a	9.87 a	247.22 a	13.67 a	2.43 a	531.33 a	788.33 a	77.74 a	245.67 a	P3	

* Similar letters show that there are no significant differences between the means according to Duncan's multiple range test, at a probability level of 5%.

We conclude from this experiment the significant and positive effect of using Vermicompost worm fertilizer in improving the vegetative growth characteristics and yield of eggplant when planted in pots. The interaction treatment (V3P3) between the highest fertilization percentage (15%) with the largest pot volume (24 liters) gave the highest values in traits of vegetative growth and yield.

References

.1 Al-Mohammadi F. Protected Agriculture, University of Baghdad-Ministry of Higher Education and Scientific Research. Baghdad, Iraq) In Arabic; 1990.

.2 Foster R. Midwest vegetable production guide for commercial growers 2003. AGRIS. 2003.

.3 salih Mahdi H, Hussein WA. Effect of Biohealth and Mineral Fertilizer in the Product and Quality of Four Varieties of Eggplant. Euphrates Journal of Agriculture Science. 2017;9(4):603-12.

.4 Abu-rian A. The Organic Agriculture (Attributes and Importance for human health). College of Agriculture, Jordan University 1st Edition Jordan p322. 2010.

.5 Sinha RK. Earthworm vermicompost. Nova Science Publishers, 2011.

.6 Chauhan HK, Singh K. Potancy of Vermiwash with Neem plant parts on the Infestation of Eariasvittella (Fabricius) and Productivity of Okra (Abelmoschus esculentus)(L.) Moench. Asian Journal of Research in Pharmaceutical Science. 2015;5(1):36-40. http://doi.org/10.5958/2231-5659.2015.00006.5

.7 Dere Ş, GÜNEŞ T, Sivaci R. Spectrophotometric Determination of Chlorophyll-A, B and TotalCarotenoid Contents of Some Algae Species Using Different Solvents. Turkish Journal of Botany. 1998;22(1):13-8.

.8 Joshi R, Singh J, Vig AP. Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth ,yield and quality of plants. Reviews in Environmental Science and Bio/Technology. 2015;14(1):137-59. https://doi.org/10.1007/s11157-014-9347-1

.9 Lim SL, Wu TY, Lim PN, Shak KPY. The use of vermicompost in organic farming: overview, effects on soil and economics. Journal of the Science of Food and Agriculture. 2015;95(6):1143-56. https://doi.org/10.1002/jsfa.6849

.10 Bres W, Weston LA. Influence of gel additives on nitrate, ammonium, and water retention and tomato

growth in a soilless medium. HortScience. 1993;28(10):1005-7.
https://doi.org/10.21273/HORTSCI.28.10.1005
.11 Mahmoud H, Qassem S, Khaled A. Effect of planting method and date on flowers and yield of tomato in the desert area of Karbala governorate Iraqi Agriculture Journal Baghdad-Iraq. 200.47-38:(1)13;8
.12 Jassem A, Abdel-Jabbar, Hussein A, Nabil J. Tomato productivity under the integrated farming system and the effect of phosphate, organic and biological fertilization on the qualitative characteristics of fruits and phosphorous concentration of tomato plants Diyala Journal of Agricultural Sciences. 2014;6(2):236-47.