The effect of utilizing chicken manure and compost as organic fertilizers on chemical properties and productivity of cucumber grown under a plastic house

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ABSTRACT

This study was conducted to assess greenhouse cucumber productivity and fruit chemical composition from the application of chicken manure and compost. Cucumber seedlings "cv. Barracuda F1" were transplanted in autumn and spring cultivation of 2021-2023 in a 8.5 x 40 m single arch plastic greenhouse at Bosaily. Each of the three beds, apart from the two side beds, was divided into three sections of about 12m, representing one replicate of each of the three treatments. Each replicate had 48 plants in two rows. The treatments were: farm waste compost, chicken manure, and the control. Compost and chicken manure were added to the bottom of the bed at a rate of 50 kg per replicate. The results showed that the total yield ranged from 1.9 to 3.3 Kg per plant. The highest early yield was obtained under chicken manure, followed by compost (1.9 and 1.8 kg/plant respectively). The application of chicken manure or compost improved cucumber productivity in the greenhouse by up to 11.5%. The effect of modifying organic matter accumulation on microelements and heavy metals in cucumber fruits was not clear as this may require further studies over a longer time. The chemical analysis of fruits showed that only Fe, Mn, and Pb were lower than the permissible limits of WHO/FAO concentration in agricultural soil. In contrast, Zn, Cu, and Cd concentrations were higher in organically amended soil. Ni concentration was higher than the limit in all treatments and all seasons. These results indicate the necessity of monitoring heavy metals in the soil, especially after successive vegetable cultivation under greenhouses.

Keywords: Pollution- Heavy metals- Fruits- Early yield.

INTRODUCTION

Cucumber(*Cumunissativus* L.) of the Cucurbitaceae family is one of the oldest cultivated vegetables for 5,000 years (Wehner and Guner, 2004). The main phytochemical constituent in cucumber is terpenoid which has medicinal properties against malaria, viral, bacterial, and fungal agents (Egwaikhide et al., 2010) as obtained from its extract (Sood et al., 2012). The soil where cucumber is cultivated requires moderate to high nutrient levels to achieve high yields. Poor soil results in bitter and deformed fruits which are often unaccepted by consumers that may reduce farmer's income (Eifediyi&Remison 2010a). Such soils are enhanced by applying fertilizers that supply additional plant nutrients and improve plant growth.

Peat, as a natural organic substance, is one of the most used substrates in soilless cultivation. However, peat mining produces a negative carbon footprint, which increases the need for alternative sustainable substrate media (Venkataramani et al., 2023). Sustainable alternatives are needed to substitute peat in the growing media. These substitutes have to be cost-effective, sustainable, and environmentally friendly, (Najarian and Souri, 2020). There are several organic materials and farm wastes have been investigated as potential substitutes for peat, including compost, manure, coconut coir, sawdust, bark, and biochar (Álvarez et al., 2018).

Poultry production in Egypt is projected to be 1.8 million metric tons by 2026. In 2021, the figure stood at 1.6 million metric tons, growing at an average rate of 2.3% each year (Kwasi et al., 2022). The annual chicken manure production in Egypt is 2.3 million tons (Mahmoud et al. 2022). This illustrates the considerable quantities of poultry manure, locally.

Based on the work of Carnimeo et al. (2022), the use of mixed compost and vermicompost can be effective and sustainable both economically and environmentally, as it stimulates plant growth, and it could represent a successful strategy to mitigate the presence of toxic residues in food plants.

Inorganic fertilizers are chemically made in a factory or obtained from mining, while organic fertilizers are composed of waste, and plant and animal residues. Application of inorganic and organic fertilizers to the soil has been shown to affect human food chain toxicity because it contains variable qualities of heavy metals (Curtis and Smith, 2002, Eifediyi and Remison, 2010b). Heavy metals are metallic elements with relatively high atomic weights in the range of 63.5–200.6 g.mol^{-1} and densities of more than 5 g.cm^{-3} (Srivastava and Majumder, 2008). These include Cu, Fe, Mn, and Zn which are essential for biochemical and physiological activities in plants at low concentrations, while Pb, Cd, As, Hg, and Ni are toxic to the environment even at their low concentrations with no established role in plants (Benavides et al., 2005). Heavy metals become toxic when ingested; and are not metabolized by the body thereby accumulating in the tissues (Godfrey et al., 2003). Soil-to-plant transfer is one of the key components of human exposure to metals through the food chain (Opaluwa et al., 2012).

This study was therefore conducted to assess greenhouse cucumber productivity and fruit chemical composition, including heavy metals, resulting from the application of chicken manure and compost.

MATERIALS AND METHODS

Site Description:

The experiments were conducted in El-Bosaily (31°40'N; 30°40'E) Protected Cultivation Experimental Farm, the Central Laboratory for Agricultural Climate (CLAC), at Beheira Governorate, on the Northern Coast of Egypt, during autumn and spring cultivations for two successive seasons of 2021-2023. All weather data was obtained from an automatic weather station in situ belonging to CLAC. Data in **Table (1)** illustrates the measured maximum, average, and minimum air temperatures (°C), as well as the maximum, average, and minimum relative humidity (%), during the experimental period October–May of 2021–2022 and 2022–2023, respectively. As could be noticed, there are no clear differences between both seasons regarding monthly average air temperature or average relative humidity.

Table (1).Average monthly air temperature and relative humidity of the Bosaily site during the two studied seasons of 2021/2022 and 2022/2023.

		Temperature (°C)			Humidity (%)		
		Maximum	Average	Minimum	Maximum	Average	Minimum
	Month	First season (2021/2022)					
Autumn	October	34.0	24.2	18.0	94.0	63.2	28.0
	November	25.5	21.3	17.6	88.2	71.0	51.7
	December	19.7	15.6	12.3	86.5	73.4	56.8
	January	17.3	13.0	9.2	88.4	73.1	54.8
Spring	February	19.0	14.0	9.2	88.5	72.2	53.3
	March	25.0	14.5	11.0	82.0	71.7	62.0
	April	38.0	20.0	16.5	82.0	64.7	47.0
	May	33.0	22.2	19.3	94.0	67.0	50.0
		Second season (2022/2023)					
Autumn	October	36.0	26.2	23.7	61.0	47.9	42.0
	November	24.5	22.5	19.9	67.4	54.6	43.9
	December	22.4	20.2	17.4	75.4	61.9	50.5
	January	20.5	17.9	15.0	79.4	64.2	49.1
Spring	February	17.9	16.0	13.9	73.9	60.8	45.1
	March	32.0	20.0	15.3	72.0	54.4	43.0
	April	35.0	22.3	17.6	64.0	52.5	44.0
	May	33.0	24.2	21.0	78.0	58.7	48.0

The physical and chemical parameters of the experimental soil at a depth of 0–30 cm were determined using the methods outlined by Page et al. (1982) and Klute (1986), and the findings are shown in **Table (2).** Bosaily soil has a loam texture and is characterized by moderate salinity and variable contents of micro and micronutrients as well as heavy metals.

Table (2).Some physical and chemical characteristics of the investigated soil.

Chemical characteristics										
pH	ECe dSm^{-1} 1:2.5	meq/l								
		Cations				Anions				
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$Cl^{=}$	CO_3^{2-}	HCO_3^{-}	SO_4^{2-}
6.24	1.04	1.92	2.32	5.36	0.8	4.48	1.92	1.44	4.96
Available elements									
	(%)				(mg/kg)				
Element	N	P	K	Fe	Zn	Cu	Ni	Cd	Pb
	0.02	0.17	6.8	840.0	207.0	24.0	64.0	0.7	10.2
Physical properties									
Soil particles (%)			Soil Texture	Field Capacity (%)	Wilting point (%)	Organic matter (%)	Bulk density		
Fine sand	Silt	Clay							
35.4	38.8	15.8	Loam	13.7	6.2	0.28	1.1		

Plant material and treatments:

Cucumber seedlings "cv. Barracuda F1" were transplanted after two weeks from planting in a regular 84-hole tray on the 7th of October 2021 and 2022 (Autumn cultivation) and 18th of February 2022 and 2023 (Spring cultivation) in a 8.5x40m single arch plastic greenhouse at Bosaily. The greenhouse consisted of five beds, and each bed had two rows. Each row was irrigated by 50-cm in-line drip irrigation tubes.

Each of the three beds, apart from the sides, was divided into three sections of about 12m, representing one replicate of each of the three treatments. Each replicate had 48 plants in two rows. The treatments were: farm waste compost, chicken manure, and chemical addition only as a control. Compost and chicken manure were added to the bottom of the bed and covered with 20 cm of soil 15 days before cultivation at a rate of 50 kg per replicate. The analysis of compost and chicken manure is illustrated in **Table (3).** Mineral fertilizers were added as recommended to all treatments. Fertigation was practiced as a regular practice for commercial greenhouse cucumbers on the farm.

Table (3).Some chemical characteristics of used compost and chicken manure.

Organic sources		Compost	Chicken manure
Macronutrients mg/100g	N	1.30	3.51
	P	0.28	0.63
	K	1.72	1.87
Micronutrients Ppm	Fe	22.4	44.7
	Zn	9.38	9.71
	Mn	1.39	1.51
	Cu	0.28	0.31
Heavy metals Ppm	Ni	0.51	0.52
	Cd	0.05	0.05
	Pb	0.13	0.15
PH		8.02	8.25
C%		35.53	62.04
C/N ratio		28.27	19.36

Chemical analysis:

Soil analysis

Soil chemical samples from a known weight of 1.0kg of finely ground were collected randomly with a hand shovel from a depth range of 0–30 cm using the methods outlined by Page et al. (1982), Klute (1986) and Abul-Soud et al. (2008) before and after each cultivation. Soil reaction (pH) was determined using a pH meter Model 18 Aqua Lytic with a glass electrode, (Richards, 1954). The electrical conductivity (EC) of soil extract (1:2.5) was determined using EC meter (YSI) Model 32.

Heavy metals constituent in the soil were determined by analyzing the soil sample using Atomic Absorption Spectrometry (AAS). The soil sample was properly placed in an aluminum foil and transported to the laboratory to air dry at room temperature for 24 hours for heavy metals analysis. The samples were digested at the National Research Center following the procedures of (A.O.A.C, 2005). The absorbance of micronutrients and heavy metals contents of all samples was read for Fe, Mn, Cu, Zn, Pb, Cd, Cr, and Ni on the Atomic Absorption Spectrophotometer.

Shoot and fruit analysis:

The shoot data were taken weekly after one month of transplanting in the greenhouse throughout the plant growth. Shoot samples were taken for weeks 1, 5, 9, and 13 for Autumn cultivation; and weeks 1, 4, 7, and 10 for spring cultivation. Fruit weight per plant was recorded at each harvest and summed to obtain the early and total yield. Yield was then calculated for a typical commercial greenhouse of the dimensions 9 x 40 m^2, having 800 plants. Early yield was the total harvest until weeks 6 and 5, while number of fruits and total yield was the total harvest until weeks 13 and 10 for Autumn and Spring cultivation, respectively. Leaf area [cm^2] was calculated from leaf length [cm] and leaf width [cm] according to the following formula suggested by Medany et al. (1996):

Leaf area = 0.667 x leaf length x leaf width - 1.25

Freshly harvested shoots and fruits were taken to the laboratory and analyzed for the presence of N, P, K, Fe, Mn, Cu, Zn, Pb, Cd, Cr, and Ni. In week 13 and 10 for Autumn and Spring cultivation, respectively. Three replicates from each treatment were collected in the last week of the season. The whole above-ground plant parts are considered a plant shoot. Three random plants were used from each replicate. The cucumber shoots and fruits were dried at 70° C for 48 hr., ground, and wet digested at CLAC. Digested samples were analyzed at the National Research Center according to the method described by Fadina et al. (2021).

Experimental design and data collection:

The experiment was arranged with three treatments in each of the three replicates. Each replicate was 12m long, containing two rows of cucumber plants 0.5m apart making 48 plants per replicate. Vegetative growth data included plant height, number of leaves per plant, leaf length, and width; while yield data included the number of fruits and fruit weight per plant. The collected data were analyzed using analysis of variance and means were separated at a probability of five percent (5%) level of significance and comparisons were made with L.S.D. values according to Snedecor& Cochran (1989).

RESULTS AND DISCUSSION

The results of studying the effect of the application of chicken manure and compost as organic amendments on the chemical properties and productivity of cucumber grown under plastic houses in Bosaily are illustrated in Tables (4, 5, 6, and 8), The results of soil analysis for nutrients and heavy metals are illustrated in Table 7. The effect of organic matter amended to the soil on the early and total yield of cucumber is shown in Table (8).

Progressive vegetative growth and number of fruits:

Periodic vegetative growth in terms of plant height, leaf number, and leaf area, in response to compost and chicken manure treatments for the cucumber plants grown during the two Spring and Autumn from 2021-2023 are shown in **Tables (4 and 5).** Plant height, number of leaves and leaf area in both Autumn and Spring cultivations of both seasons showed that chicken manure and compost gave significantly higher values for all measured parameters compared to the control. It is noticeable that the first half of growing had higher values in the chicken manure than compost, while the last half of the plant cycle was the opposite. The final plant height under compost treatment was 23.5, 21.5, 2.4, and 3.5% higher than the control for Autumn 2021, 2022, and Spring 2022, 2023, respectively, while under chicken manure treatment was 17.8, 20.0, 4.0, and 2.4%, higher than control, respectively. A similar trend was observed in leaf area. This could be attributed to the higher nitrogen content in the chicken manure than compost (Table 3), which enhanced vegetative growth for the first few weeks (Eifediyi&Remison, 2010b; &Fadina et al. 2021).

Table (4): Effect of compost and chicken manure on some parameters of cucumber plants during autumn 2021 and 2022.

Parameter	Treatment	Sampling date (weeks)			
		1	5	9	13
Autumn 2021					
Plant	Control	133.38	194.67	241.29	294.12
Height	Compost	162.76	241.06	294.52	363.20
[cm]	Chicken manure	166.11	261.14	302.82	346.61
	L.S.D 5 %	7.07	2.51	1.81	7.09
Leaf	Control	110.43	142.38	167.31	269.28
Area	Compost	133.38	182.09	211.68	331.45
[cm^2]	Chicken manure	135.56	162.23	185.75	341.99
	L.S.D 5 %	1.27	3.18	5.21	10.27
No.	Control	10.89	31.68	39.60	39.60
Of	Compost	10.00	33.00	38.00	39.00
leaves/plant	Chicken manure	13.00	39.00	39.00	38.00
	L.S.D 5 %	1.85	3.55	N.S	N.S
Autumn 2022					
Plant	Control	48.87	212.31	263.16	293.22
Height	Compost	69.98	258.34	329.18	356.40
[cm]	Chicken manure	65.84	251.90	318.57	351.86
	L.S.D 5 %	1.10	2.31	4.56	3.16
Leaf	Control	101.61	118.71	170.91	267.57
Area	Compost	137.59	164.48	308.12	343.98
[cm^2]	Chicken manure	141.12	170.31	228.06	312.69
	L.S.D 5 %	7.23	7.48	24.86	2.19
No.	Control	7.20	16.20	21.60	22.50
Of	Compost	9.72	21.60	27.00	28.08
leaves/plant	Chicken manure	9.45	21.00	26.25	27.30
	L.S.D 5 %	N.S	2.23	3.42	2.09

Table (5).Effect of compost and chicken manure on some parameters of cucumber plants during spring 2021 and 2022.

Parameters	Treatment	Sampling date (weeks)			
		1	4	7	10
		Spring 2022			
Plant	Control	98.80	196.80	252.00	294.10
Height	Compost	102.50	206.80	259.00	301.30
[cm]	Chicken manure	108.50	214.70	264.00	305.90
	L.S.D 5 %	1.79	2.69	4.90	2.19
Leaf	Control	142.70	325.40	355.80	392.50
Area	Compost	201.10	331.30	371.50	417.00
[cm^2]	Chicken manure	230.20	396.30	414.30	469.60
	L.S.D 5 %	23.10	35.70	41.80	26.10
No.	Control	24.00	25.00	20.00	20.00
Of	Compost	25.00	25.00	19.00	19.00
leaves/plant	Chicken manure	25.00	24.00	20.00	20.00
	L.S.D 5 %	N.S	0.98	N.S	N.S
		Spring 2023			
Plant	Control	94.20	179.30	251.30	305.00
Height	Compost	104.30	193.30	255.00	315.60
[cm]	Chicken manure	103.40	197.10	259.00	312.40
	L.S.D 5 %	N.S	2.10	1.32	2.19
Leaf	Control	128.10	292.00	331.30	377.60
Area	Compost	218.80	297.80	333.40	424.10
[cm^2]	Chicken manure	256.70	386.40	432.60	458.60
	L.S.D 5 %	27.90	39.78	33.45	36.72
No.	Control	24.00	25.00	25.00	25.00
Of	Compost	25.00	25.00	26.00	26.00
leaves/plant	Chicken manure	25.00	24.00	26.00	25.00
	L.S.D 5 %	N.S	N.S	N.S	N.S

Chemical composition of shoots and fruits

The results obtained because of compost and chicken manure amendment on the concentration of N, P, K, [%]; Fe, Zn, Mn, Cu, Ni, Cd, and Pb [ppm] in cucumber shoots and fruits during four cultivations from 2021-2023 are illustrated in **Table (6).** Nitrogen and phosphorus showed small differences between treatments and seasons. Potassium content in shoots was higher under chicken manure treatment followed by compost than in the control, while in fruits was higher under compost than in chicken manure, followed by the control. the control of all cultivation dates. The concentrations of different tested micronutrients and heavy metals in shoots were as follows: Fe concentration in fruits ranged from 78.75 to 336.0; Zn 48.83 to 76.65; Mn from 0.13 to 0.18; Cu from 47.57 to 67.20; Ni from 26.46 to 58.10; Cd from 0.05 to 0.08; Pb from 2.73 to 22.58 ppm.

FAO/WHO maximum permissible values of heavy metals (ppm) in vegetables were Fe 425.5; Zn 99.4; Mn 0.2; Cu 73.3; Ni 67.9; Cd 0.2; and Pb 0.3 (Codex, 2001; Mensah et al., 2009; World Health Organization, 2021). All elements in fruits were under the permissible values, specifically, Fe concentration in fruits ranged from 78.75 to 336.0; Zn 48.83 to 76.65; Mn from 0.13 to 0.18; Cu from 47.57 to 67.20; Ni from 26.46 to 58.10; Cd from 0.05 to 0.08; and Pb from 0.02 to 0.10 ppm. In general, concentrations under control were lower than the chicken manure and compost, with no clear trend between chicken manure and compost. Nevertheless, the effect of the accumulation of organic matter amendment on micronutrients and heavy metals in cucumber fruits was not clear as this may require further studies over a longer time. These results agreed with Mensah et al.(2009), Eifediyi and Remison, (2010a) and Fadina et al.(2021).

Table (6): Effect of compost and chicken manure on the concentration of some macro (%), micronutrients, and heavy metals (ppm) in cucumber shoots and fruits during four cultivations from 2021-2023.

Treatments / Element	Control	Compost	Chicken manure	Control	Compost	Chicken manure
	Final shoots			Final fruits		
	Autumn 2021					
N	2.08	2.47	2.32	1.39	2.57	2.50
P	0.36	0.47	0.69	0.21	0.40	0.76
K	2.86	3.45	3.65	2.57	6.05	3.73
Fe	0.32	0.47	0.69	0.89	2.99	3.36
Zn	0.27	0.38	0.46	0.49	0.55	0.66
Mn	0.17	0.19	0.22	0.13	0.17	0.15
Cu	0.07	0.09	0.09	0.56	0.62	0.67
Ni	0.18	0.20	0.20	0.82	0.93	0.09
Cd	0.02	0.02	0.03	0.06	0.05	0.07
Pb	0.03	0.03	0.06	0.27	0.31	0.31
	Spring 2022					
N	2.10	2.55	2.43	1.41	1.93	2.02
P	0.37	0.51	0.74	0.48	0.56	0.55
K	2.96	3.58	4.32	3.18	4.42	3.87
Fe	0.32	0.45	0.66	0.79	2.26	3.05
Zn	0.28	0.40	0.49	0.54	0.62	0.77
Mn	0.18	0.19	0.23	0.13	0.18	0.15
Cu	0.08	0.09	0.10	0.58	0.66	0.91
Ni	0.19	0.21	0.22	0.85	0.93	0.90
Cd	0.02	0.02	0.03	0.06	0.08	0.07
Pb	0.03	0.03	0.06	0.28	0.32	0.33
	Autumn 2022					
N	1.74	1.82	2.09	1.72	2.61	2.66
P	0.41	0.51	0.65	0.69	1.39	1.09
K	2.96	3.51	4.42	3.01	6.00	4.60
Fe	0.32	0.44	0.68	0.86	1.64	2.13
Zn	0.18	0.24	0.37	0.56	0.98	0.90
Mn	0.13	0.18	0.24	0.15	0.19	0.17
Cu	0.05	0.07	0.10	0.48	0.54	0.58
Ni	0.16	0.21	0.23	0.26	0.31	0.30
Cd	0.01	0.01	0.02	0.06	0.07	0.06
Pb	0.14	0.18	0.20	0.26	0.32	0.29
	Spring 2023					
N	1.79	1.91	2.11	1.59	2.25	2.37
P	0.46	0.59	0.70	0.76	1.46	1.31
K	3.05	3.82	4.64	3.05	6.14	4.68
Fe	0.31	0.42	0.65	0.79	1.58	2.01
Zn	0.21	0.28	0.42	0.56	1.00	0.95
Mn	0.16	0.19	0.26	0.19	0.20	0.20
Cu	0.06	0.09	0.13	0.49	0.59	0.62
Ni	0.19	0.28	0.29	0.30	0.31	0.31
Cd	0.01	0.02	0.02	0.06	0.08	0.07
Pb	0.15	0.20	0.23	0.28	0.32	0.33

Chemical composition of soil

The results obtained because of compost and chicken manure amendment on total extractable amounts of N, P & K (%); Fe, Zn, Mn, Cu, Ni, Cd, and Pb (ppm) as well as pH in the amended organic treatment cultivated with cucumber during four cultivations from 2021-2023 are illustrated in Table (7). The WHO/FAO (2001) permissible limit of Fe is 50000; Zn is 300; Mn is 2000; Cu is 100; Ni is 50; Cd is 3 and Pb is 100 ppm (Chiroma et al., 2014). The results illustrated in **Table (7)** show that N concentration in compost and chicken manure treatment ranged from 5.6 to 9.8 folds the concentration in the control soil, while P and K ranged from 4.1 to 7.6 and k 1.7 to 3.1 folds, respectively. These results indicated the importance of enrichment of soil by the amendment of organic manure, either in the form of compost or chicken manure.

Regarding micronutrients and heavy metals, it was found that only Fe, Mn, and Pb were lower than the permissible limits of WHO/FAO concentration in agricultural soil. In contrast, Zn, Cu, and Cd concentrations were higher in organically amended soil. Ni concentration was higher than the limit in all treatments and all cultivations. The high concentrations of Zn, Cu, and Cd could be attributed to insecticides, fungicides, and commercial fertilizers that use such elements in agriculture (Okoro et al., 2012). These results indicate that there is a need for monitoring heavy metals in soils, especially after successive cultivation of vegetables under greenhouses (Curtis, & Smith, 2002, Chiroma et al., 2014 and Jalali&Mujahid, 2020).

Table (7): Total extractable amounts of some macro (%); micronutrients, heavy metals (mg/kg), and pH in the amended organic soils cultivated with cucumber during four cultivations from 2021-2023.

Treatments / Element	Control	Compost	Chicken manure	Control	Compost	Chicken manure
	Autumn 2021			Autumn 2022		
N	0.02	0.10	0.10	0.02	0.13	0.13
P	0.17	0.72	0.87	0.13	0.61	0.76
K	6.85	20.44	21.29	7.60	18.30	20.01
Fe	840.0	2320.0	2300.0	480.0	3200.0	3170.0
Zn	207.0	430.0	445.0	180.0	371.0	350.0
Mn	87.0	430.0	422.0	153.0	384.0	387.0
Cu	24.0	124.0	150.0	33.0	57.0	77.0
Ni	64.0	112.0	142.0	84.0	210.0	207.0
Cd	0.7	6.3	5.8	0.7	3.1	3.0
Pb	10.2	16.2	17.1	20.2	18.1	18.2
pH	7.83	7.62	7.93	8.03	7.83	8.03
	Spring 2022			Spring 2023		
N	0.02	0.20	0.21	0.02	0.10	0.12
P	0.15	0.68	0.79	0.12	0.78	0.90
K	9.84	21.08	21.72	9.95	16.91	17.23
Fe	876.5	2709.8	2520.3	564.3	3053.3	3307.1
Zn	282.3	492.9	488.1	206.0	485.6	486.6
Mn	82.7	368.6	441.5	63.6	164.4	210.3
Cu	9.4	145.0	164.5	29.0	376.9	245.0
Ni	75.7	198.9	269.1	73.7	244.2	248.2
Cd	0.5	1.6	1.3	0.9	0.6	1.3
Pb	10.2	27.1	30.4	15.4	37.6	41.3
pH	7.80	7.20	7.30	7.93	7.42	7.73

Yield:-

The results obtained because of compost and chicken manure amendment on cucumber early yield, number of fruits per plant, and total yield in Bosaily for two Autumn cultivations (2021 & 2022) and two Spring cultivations (2022 and 2023) are illustrated in **Table (8).** The results show that the average early yield for all cultivation was 1.278, 1.590, and 1.590 Kg/ plant for control, compost, and chicken manure, respectively.

The number of cucumber fruits per plant was higher under chicken manure and compost treatment than the control for Autumn 2021, 2022, and Spring 2022, 2023, respectively. Moreover, the average total yield in both seasons was 2.276, 2.666, and 2.792, respectively. Early or total yield was significantly higher for chicken manure than compost followed by control treatment in spring cultivations. In autumn cultivations, there were insignificant differences between chicken manure and compost. The total yield in compost treatment at autumn cultivations was 11.5% higher than spring cultivation chicken manure, with small differences in the other two treatments. The total yield under control, compost, and chicken manure treatments ranged from 1.9-2.7; 2.3-3.3; and 2.5-3.1 kg/plant respectively. These results agreed with those obtained by Abul-Soud et al. (2008),Eifediyi&Remison, (2010 a) Fadina et al. (2021) andCarnimeo et al. (2022).

Table (8): Effect of compost and chicken manure on early and total cucumber yield (ton/ greenhouse) as well as number of fruits per plant for both cultivations during 2021-2023.

Treatments	Early yield		Total yield		Number of fruits	
	ton/greenhouse 8.5x40				# Per plant	
			Autumn 2021			
Control	1.416	b*	2.688	c	27.80	b
Compost	1.848	a	3.296	a	31.89	a
Chicken manure	1.872	a	3.096	b	30.96	a
L.S.D 0.05	0.068		0.123		1.20	
			Spring 2022			
Control	1.368	c	2.296	c	25.50	a
Compost	1.496	a	2.472	b	28.11	b
Chicken manure	1.464	b	2.656	a	30.29	b
L.S.D 0.05	0.028		0.160		2.41	
			Autumn 2022			
Control	0.984	c	1.928	c	22.42	a
Compost	1.328	a	2.328	b	29.08	b
Chicken manure	1.240	b	2.520	a	28.20	b
L.S.D 0.05	0.017		0.160		2.65	
			Spring 2023			
Control	1.344	c	2.192	c	24.35	b
Compost	1.688	b	2.568	b	27.53	a
Chicken manure	1.784	a	2.896	a	27.98	a
L.S.D 0.05	0.080		0.027		1.62	

*Similar letters indicate insignificant differences at 0.05 level.

Conclusion:-

The study ofutilizing chicken manure and compost as organic fertilizers amendment on cucumber grown in Bosaily, Northern Nile Delta, for Autumn and Spring cultivations (2021 and 2023) under a typical plastic house of 9x40m^2 concluded that total yield ranged from 1.9 to 3.3 tons per greenhouse. The highest early yield was obtained under chicken manure (1.9 t/house), followed by the compost (1.8 t/house) treatment. The highest total yield was obtained under compost (3.3), followed by the chicken manure (3.1 t/house) treatment. Therefore, the application of chicken manure or compost improved cucumber productivity in the greenhouse by up to 11.5%. The effect of the accumulation of organic matter amendment on micronutrients and heavy metals in cucumber fruits was not clear as this may require further studies over a longer time. The chemical analysis of fruits showed that only Fe, Mn, and Pb were lower than the permissible limits of WHO/FAO concentration in agricultural soil. In contrast, Zn, Cu, and Cd concentrations were higher in organically amended soil. Ni concentration was higher than the limit in all treatments and all cultivations. These results indicate that there is a need for monitoring heavy metals in soils, especially after successive cultivation of vegetables under greenhouses.

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تأثير التسميد العضوي بزرق الدواجن والكمبوست على الخواص الكيميائية والإنتاجية لنباتات الخيار النامية بالصوبة البلاستيكية

غاده رضوان وانجى سلطان

المعمل المركزى للمناخ-مركزالبحوث الزراعيه

أجريت هذه الدراسة لتقييم إنتاجية خيار الصوب والتركيب الكيميائي للثمار، بما في ذلك المعادن الثقيلة، نتيجة لإضافة لزرق الدواجن والكمبوست. تم زراعة شتلات الخيار "هجين باراكودا" بعد اسبوعين من زراعتها في صينية عادية ذات 84 عين في 7 أكتوبر 2021 و 2022 (العروة الخريفية) و18 فبراير 2022 و2023 (العروة الربيعية) في صوبة بلاستيكية ذات نفق واحد 40x8.5 متر في موقع البوصيلي، في شمال الدلتا. تم تقسيم كل مصطبة من المصاطب الثلاثة، باستثناء المصطبتين الجانبيين، إلى ثلاثة أقسام يبلغ طول كل منها 12 مترًا، مما يمثل مكررة واحدة من كل من المعاملات الثلاثة. زرع بكل مكررة 48 نباتًا فعلى ريشتين، وكانت المعاملات: سماد كمبوست، زرق دواجن، والكنترول (إضافات كيماوية فقط). تم إضافة الكمبوست وزرق الدواجن بخندق تحت المصطبة وتغطيته بـ 20 سم من التربة قبل الزراعة بـ 15 يوم، وبمعدل 50 كجم لكل مكررة (تعادل 800كجم/صوبة). أظهرت النتائج أن الإنتاج الكلي تراوح بين 1.9 إلى 3.3 طن لكل صوبة. تم الحصول على أعلى إنتاج مبكر في معاملة زرق الدواجن (1.9 طن/صوبة)، تليها معاملة الكمبوست (1.8 طن/صوبة). تم الحصول على أعلى إنتاجية إجمالية تحت معاملة الكمبوست (3.3)، تلتها معاملة زرق الدواجن (3.1 طن/صوبة). لذلك، أدى استخدام زرق الدواجن أو الكمبوست إلى تحسين إنتاجية الخيار بالصوبة بنسبة تصل إلى 11.5%. لم يكن تأثير تعديل تراكم المادة العضوية على العناصر الصغرى والمعادن الثقيلة في ثمار الخيار واضحاً، حيث قد يتطلب ذلك المزيد من الدراسات على مدى فترات أطول. أظهر التحليل الكيميائي للثمار أن الحديد والمنجنيز والرصاص فقط كانت أقل من الحدود المسموح بها لتركيزات منظمة الصحة العالمية ومنظمة الأغذية والزراعة في التربة الزراعية. في المقابل، كانت تركيزات الزنك والنحاس والكادميوم أعلى في التربة المسمدة عضوياً. وكان تركيز النيكل أعلى من الحد المسموح به في جميع المعاملات وجميع العروات. وتشير هذه النتائج إلى ضرورة مراقبة العناصر الثقيلة في التربة، خاصة بعد زراعة الخضر المتعاقبة تحت البيوت المحمية.