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(Original Article)

The Role of Composting and Vermicomposting with Biochar in Nutrient Uptake and Plant Growth of Tomato and Jew's Mallow Grown on Calcareous Sandy Soil

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Abstract

Amending soils with biochar and vermicompost receive great attention in agriculture as it has the potential to provide multiple benefits for improving soil properties and thus enhancing plant growth and yield. Therefore, the objective of this research was to evaluate the influence of vermicompost (VCOM) and vermicompost produced in the presence of biochar (VCOM-BC) on nutrient uptake, and tomato (*Solanum lycopersicum* L) growth as well as the residual effect of treatments on Jew's mallow (*Corchorus Olitorius* L). A pot experiment included five treatments; 1) Compost (COM), 2) Compost produced in the presence of biochar (COM-BC), 3) Vermicompost (VCOM), 4) Vermicompost produced in the presence of biochar (VCOM-BC), and 5) Control. The results showed that organic amendments had a positive impact on root and shoot fresh and dry weight of tomato plants. The maximum dry matter (2.90 g/plant) was produced in VCOM treatment followed by VCOM-BC treatment (2.27 g/plant), which was higher than control soil by 5.1 and 4 folds, respectively. The root dry weight of tomato plants increased significantly when grown in soil treated with organic amendments except for COM-BC, with the maximum root dry weight found in tomato plants grown in VCOM treatment followed by VCOM-BC. Applying organic amendments led also to a significantly higher increase in fresh and dry weights of Jew's mallow shoots and roots compared to the control soil, with no significant differences between most organic amendments. In most cases, VCOM and/or VCOM-BC showed the highest increases in nutrient (NPK) uptake. Therefore, the application of vermicompost or biochar-amended vermicompost could be an effective nutrient management strategy for tomato and Jew's mallow in Egypt's newly reclaimed calcareous soils.

Keywords: *Arid soils, Biochar, Nutrition status, Soil amendments, Worm composting.*

Introduction

Increasing agricultural productivity through cultivation of recently reclaimed sandy and calcareous soil is necessary to meet the world's rapidly growing needs for food. The calcareous sandy soils are thought to make large areas of the

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terrestrial surface on Earth and Egypt. Numerous difficulties arise when cultivating calcareous soils, including low water retention, low levels of humus and clay, low CEC, high rates of infiltration, nutrient loss through leaching, and poor structural integrity. In addition to problems caused by high $CaCO_3$ content, which can reach up to 95% (Meshram *et al*., 2023), such as surface crusting, low availability of macronutrients particularly phosphorous (P) and micronutrients, and imbalance between nutritional elements such as magnesium (Mg), potassium (K), and calcium (Ca), high pH and low nitrogen (N) use efficiency (El-Hady and Abo-Sedera, 2006). On the other hand, continuous overuse of inorganic fertilizers results in several problems, especially when applied at high rates; which causes water and air pollution, and greenhouse gas emissions (Wu *et al*., 2005) .

Many studies have demonstrated positive impact of organic amendments on calcareous soils. In this context, the application of organic amendments to the soil, as an alternative to mineral fertilization, can increase soil microorganism activity and nutrient content of soil and may also promote nutrient release and decomposition of organic matter , plant uptake, and nutrient elements utilization (Phares and Akaba, 2022). Worm composting or vermicomposting is another major type of composting that is considered a sustainable method for recycling biodegradable organic waste (Lv *et al.,* 2020), also defined as a bio-oxidative process in which earthworm detritions interact with microorganisms and other fauna within the decomposer community, thus increasing organic matter stabilization of soil and significantly modifying its physical and biochemical properties (Domínguez, 2004). Recent studies have shown that vermicompost enhances photosynthesis, plant nutrition, and crop quality in general, mainly due to adding essential nutrients, growth-regulating hormones, and enzymes to the soil (Liu *et al*., 2022)*;* (Oyege and Balaji Bhaskar, 2023).

Recently, Biochar, a carbon-rich material derived from waste biomass, has a positive impact on improving soil properties (Pandey *et al*., 2020). Additionally, adding biochar during vermicomposting is of important for nutrient cycling and carbon stabilization (Huang *et al*., 2022). Adding biochar to the composting substrate before vermicomposting has a positive impact on overall chained process of composting to vermicomposting. Biochar might accelerate the vermicomposting process and improve the end product's quality when added during the process, further increasing the number of active bacteria and eukaryotes (Huang *et al*., 2022) in addition to celluloses, alkaline phosphatase, protease, actinobacteria and firmicutes (Cao *et al*., 2021). Previous research has shown that using biochar with VCOM can increase its stability and reduce the solubility of organic materials (Doan *et al.,* 2013). Additionally, application of VCOM-BC to soils improved the parameters of soil quality and plant growth. Tasnim *et al.* (2021) investigated the application of vermicomposting with biochar on soil properties and crop yields. They suggested that the germination index, root elongation, and seed germination were all higher in vermicomposting with biochar than sole vermicomposting. Therefore, the current study aims to investigate the role of composting or vermicomposting with biochar on nutrient uptake and plant growth of tomato and Jew's mallow grown in calcareous sandy soil.

Materials and Methods

The experiment was carried out in three phases: (i) composting and vermicomposting of agricultural wastes with and without Biochar, (ii) pot experiment with tomato plants for studying the effect of organic amendments on nutrient availability and plant growth, and (iii) pot experiment with Jew's mallow for studying the residual effect of the obtained organic amendments.

Organic amendments preparation

Organic amendments used in this study were Compost (COM), compost produced in the presence of biochar (COM-BC), vermicompost (VCOM), and vermicompost produced in the presence of biochar (VCOM-BC). For composting, the wheat straw is air-dried and cut into 4–5 cm lengths. The biochar was produced by slow pyrolysis of wood chips of camphor tree at 400±10 °C in a transportable ring kiln with a residence time of 8 h. The biochar was crushed into particles and sieved to a size < 2 mm before application. The mixture from agricultural wastes of sheep manure (SM) and wheat straw (WS) in the ratio of 5:1 (w/w) was made and kept for pre-composting for about a month to avoid the thermophilic stage of composting. COM-BC was prepared following the same procedure, except for Camphor tree biochar (CTB) which was used at a rate of 10% (dry weight basis) (Awasthi *et al.,* 2020) . The pre-composted substrates of both COM and COM-BC were taken and distributed on 2 boxes (for each group) for vermicomposting and composting. The vermicomposting plastic box was 1.2 m^3 i.e., (height × length × width) (8 cm -15 cm -10 cm), with tight-fitting lids, drainage holes in the bottom, and air vents on the lids. Two boxes, VCOM and VCOM-BC, each containing approximately 75-100 healthy adult *Eisenia fetida* (red wigglers) worms with an average total weight of 36.3 g were placed on the surface of substrates. In addition, the two other boxes COM and COM-BC without any earthworms, were also set aside for composting. Earthworms were obtained from the Central Laboratory for Agriculture Climate in Giza, Cairo, and kept in their culture till the experiments. VCOM-BC was prepared following the same procedure of VCOM, in addition, biochar was used with an application rate of 10 % to avoid negative effects on worms (Weyers and Spokas, 2011). Every box with and without earthworms was covered with wet burlap.

The temperature and moisture content were maintained by sprinkling an adequate quantity of water at frequent intervals. The harvesting of vermicompost and compost was done on the 90th day. Organic amendments (COM, COM-BC, VCOM, and VCOM-BC) were air-dried for one week before use, ground to pass through a 0.2 mm sieve and stored in plastic bags for further analysis. Each sample was analyzed for pH, EC (from 1:10 w/v). Total carbon (C), hydrogen (H), nitrogen (N), and sulfur (S) were analyzed using CHNS-analyzer.

Soil sampling and characteristics

Soil used in the current experiment was calcareous sandy soil, which was collected from El-Ghorieb farm, Assiut University, Assiut, Egypt. The soil samples were air-dried and sieved through a 2 mm pore sieve. Soil texture was determined using the pipette method (Schlichting *et al.*, 1995). Chemical soil properties (pH; EC; OM; and soluble cations and anions) were determined according *to* Jackson, (1973). Table 1 shows the physical and chemical properties of a representative soil sample. Soil analysis data showed that the soil contained 92.01% sand, 4.72% silt, and 3.27 % clay. The soil pH (measured in a 1:1 suspension of soil to water) had a value of 8.50. Meanwhile, EC (measured in 1:1 extract of soil to water) had a value of 1.12 dS/m and a high $CaCO_3$ content of 17.09%. The level of organic matter accounted for 0.12 %. Additionally, the soluble Ca, Mg, Na, K and Cl were 2.6, 1.3, 5.4, 0.5, and 5.2 meq/kg soil. The available form of soil P had a value of 4.86 mg/kg.

Table 1. Physical and chemical properties of soil used in the experiment.

Soil property	Values
Particle size distribution	
Silt, %	4.72
Clay, %	3.27
Sand, %	92.01
Texture	Sandy
EC $_{(1:1)}$ dSm^{-1} at 25°C	1.12
pH $_{(1:1)}$	8.50
Calcium carbonate, %	17.09
Organic matter, %	0.12
Soluble ions meq/kg soil	
Ca^{++}	2.6
Mg^{++}	1.3
Na^{+}	5.4
K^{+}	0.5
Cl^{-}	5.2
Available p (ppm)	4.86

Pot experiment

Pot experiments were carried out to examine the effect of prepared organic amendments (COM, COM-BC, VCOM and VCOM-BC) on nutrients uptake, tomato growth, and their residual effect on Jew's mallow plants. Tomato seeds were sowed individually into cell plug trays filled with the growing media. The seedlings were transplanted to the respective experimental pots on the chosen soil. The five treatments were used: control (CK), compost (COM), biochar amended compost (COM-BC), vermicompost (VCOM), and biochar amended vermicompost (VCOM-BC). Each plastic pot (20 cm diameter and 18 cm height) was filled with 4 kg air-dried newly reclaimed calcareous sandy soil. The soil was amended with 1% (wt/wt) of each organic amendment. One plant was transplanted per pot, on 23 November 2022. Treatments were arranged in randomized complete block design, with three replicates. The second pot experiment was conducted on

1 May 2023 in the same pots of tomato plants experiment after harvesting. It aimed to evaluate the residual effect of organic amendments on nutrient availability, soil fertility, and plant production of Jew's mallow (*Corchorus Olitorius L*), family *Tiliaceae*. After 7 days of sowing, seedlings were thinned and 40 healthy seedlings in each pot were kept in each pot.

The applied mineral NPK fertilizers were added with the ratio of 100% of the recommended dose, as ammonium nitrate (33.5% N), superphosphate (15% P_2O_5), and potassium sulfate (48% K_2O). The fertilizer recommendation on feddan basis (1 feddan = 4200m^2) was applied to all treatments at the rates of 150 kg N, 150 kg P_2O_5 and 100 kg K_2O/ fed for tomato plants and at the rates of 200 kg N, 100 kg P_2O_5 and 100 kg K_2O/ fed for Jew's mallow plants. P fertilizers were added to soil, and N and K fertilizers were added with irrigation water. Plants were harvested and data were recorded on 9 January 2023 for tomato and on 14 June 2023 for Jew's mallow. Soil sample was taken from each plot (3 replications) at the end of the season for soil chemical analysis.

Growth parameters and analysis of plants and soil

At the end of the experiment, various growth parameters like plant height (cm), shoot fresh and dry weight (g), root fresh and dry weight (g) were recorded. plant shoots and roots were collected, dried at 70°C, and digested using a wet digestion procedure (HNO_3/H_2O_2) (Jones *et al*., 1991) for further nutrient analyses to determine nutrient content and uptake of nutrients. Total nitrogen in shoot and root samples was assessed through Kjeldahl digestion method (Jackson, 1973). Additionally, the concentration of K and P in the plant digests was measured using flame photometer and spectrophotometer, respectively. Soil samples were taken from the pots and sieved with a 2 mm sieve. The soil pH was measured using a pH meter in a 1:1 soil to water suspension, and EC was measured in 1:1 soil to water extracts using the EC meter.

Statistical analysis

There were three replicates for each treatment to carry out statistical analysis. The data of the plant and soil analysis were subjected to the analysis of variance (ANOVA) to assess the effect of different amendments on tomato, Jew's mallow and plant growth. LSD (Least significant difference) test at 0.05 level was used to compare the treatment effect.

Results and Discussion

Characteristics of the applied amendments

Table 2 shows the characteristics of studied samples of vermicompost and compost.

Our results found that the pH value of vermicompost and compost ranged from 7.3 to 7.7, this might be because of the used feed stock material. The sample of vermicompost has pH higher than those of compost sample and adding biochar could reduce pH value of organic amendments. The pH value of vermicompost was near that obtained by Biabani *et al*. (2018) , who reported that, 75% sheep manure and 25% wheat straw had pH value of 7.6. Some other researchers reported rise in pH during vermicomposting of biowastes (Soobhany *et al*., 2015). Addition of biochar during vermicomposting of biowastes could reduce the pH due to rapid mineralization of OM (Fu *et al*., 2015).

Table 2. Chemical characteristics of the used organic amendments

Organic amendments	pH $_{(1:10)}$	EC dS/m	C%	H%	S%	N%	C/N ratio
COM	7.43	3.8	11.22	0.925	0.788	0.65	17.26
COM-BC	7.35	3.2	20	1.206	0.791	0.73	26.66
VCOM	7.7	3.4	10.5	0.877	0.767	0.80	13.12
VCOM-BC	7.5	2.8	14	0.989	0.938	0.45	31.11

COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar.

EC ranged between 2.8 and 3.8 dS/m. The results show that VCOM had EC value lower than COM and the lowest EC value was in VCOM-BC (Table 2). Singh *et al*. (2014) attributed the decrease in EC of vermicomposted paddy and wheat straw with farmyard manure to production of ammonium ions (NH_4^+), as well as loss of the dissolved salts in the environment. Additionally, Mahaly *et al*. (2018) reported that, the changes in the EC during vermicomposting were attributed to the utilization of soluble salts by microorganisms for biosynthesis and also to the adsorption of soluble salts by earthworms. The decreases of EC value during the vermicomposting was also reported by Arora and Kaur (2019). Biochar may help to reduce salinity by holding nutrients and could be attributed to the sorption of cations on the reactive surfaces within the high pore space of biochar (Picca *et al*., 2023).

The concentration of macro and micronutrients as well as the quality of the finished compost are positively impacted by the addition of biochar during the composting and vermicomposting of biowastes as shown in (Table 2). Total Organic Carbone (TOC) content ranged from 10.5 – 20% in organic amendments. This result indicated that COM-BC and VCOM-BC had higher TOC than COM and VCOM. The decreases in TOC of vermicompost is associated with the process of mineralization, which is the transformation of organic carbon into CO_2 through the respiration of organisms (Sharma and Garg, 2018). Meanwhile biochar increased the total carbon of composting (Chowdhury *et al*., 2014). As well as the H and S content of organic amendments have the same trend. COM-BC and VCOM-BC have the highest H values of 1.20 and 0.98 than that of COM and VCOM (0.92 and 0.87). Sulfur has the highest value of 0.79, 0.93 in COM-BC and VCOM-BC that of COM and VCOM 0.78, 0.76. The results by Prost *et al*. (2013) reported significant increase in concentration of various nutrients and carbon (C) in the composted biochar.

Total nitrogen (TN) ranged from 0.45-0.80%, slightly higher after vermicomposting and in general lower in COM-BC and VCOM-BC than COM and VCOM. The increase of TN in the final vermicompost is due to the reduction of dry mass in terms of carbon dioxide during the oxidation of organic matter. In addition, the earthworms can enhance nitrogen levels during vermicomposting through the digestion of substrate in their gut and simultaneous addition of nitrogenous excretory products, mucous, body fluid, enzymes which are retained to the vermicompost as a casts; besides the decay of dead tissues of warms in the vermicomposting system (Joseph, 2019). Additionally, biochar is helpful in composting because it accelerates the organic matter's degradation and has the capacity to absorb significant amounts of NH_3, which is produced by the mineralization of organic matter (Sánchez-García *et al*., 2015) and adsorption of humic substances (Hua *et al*., 2009).

The C:N ratio in organic amendments indicates their maturity. COM, COM-BC, VCOM and VCOM-BC are characterized by a C:N ratio of 17.26, 26.66, 13.12, and 31.11. these results are in harmony with the obtained by the previous results. Moldes *et al*. (2007) stated that compost might be considered mature when C/N ratio is approximately 17 or less. Another study showed that a C/N lower than 21 indicating adequate maturity of compost (Leege, 1998). However, Khan *et al*., (2014) suggested that for co-composted biochar, the maturity of the compost could be reached at higher C/N ratios due to the high stability of biochar C, as seen in this study (Table 2). Sharma and Garg (2018) processed other types of waste mixtures (composed of cattle manure, rice straw and paper) and obtained a broader range of C:N ratios (from 12.23 to 38.85), thus demonstrating a varying degree of vermicompost maturity. Most of the studies found that biochar addition during composting increased the C/N ratio because of the recalcitrant carbon derived from the added biochar (Chowdhury *et al*., 2014).

Treatments effect on soil pH and EC

In the present study, the chemical properties of the studied soil (pH and EC) were affected by organic amendments (Table 3). The results showed that the soil additives used (except for COM at first season) had no significant impact on soil pH. Among all amendments, only COM at first season reduced the soil pH significantly from 7.9 to 7.8. The obtained results confirm finding from Walker *et al*. (2003) that addition of compost to soil led to decrease soil pH. The production of organic acids (amino acid, glycine, cysteine and humic acid) during mineralization (amminization and ammonification) of organic materials by heterotrophs and nitrification by autotrophs would have caused this decrease in soil pH. For the residual effect, applying organic amendments also had no significant effect on soil pH change this might be mainly due to the buffering capacity of the used soil. The sensitivity of soil pH to the organic amendments was likely due in part to the low buffering capacity (Neilsen *et al*., 1998). An explanation for the little difference in the pH values between treatments is indicated by Lao *et al*., (2003) who mention that the soil buffering capacity keeps pH within certain limits even using nutrient solutions of different composition.

Table 3. Treatments effects on soil pH and EC.

Treatments	pH	EC (dS/m)
First experiment (soil of tomato plants)		
CK	7.960a	1.36b
COM	7.813b	2.32a
COM-BC	7.903ab	2.87a
VCOM	7.956a	2.23a
VCOM-BC	7.946ab	2.36a
Mean	7.91b	2.23a
LSD_1 at $p = .05$	0.14	0.72
Second experiment (Residual effect, soil of Jew's mallow plants)		
CK	8.26a	1.22a
COM	8.17a	0.92a
COM-BC	8.14a	0.83a
VCOM	8.20a	0.86a
VCOM-BC	8.18a	0.92a
Mean	8.19a	0.95b
LSD_2 at $p = .05$	0.20	0.54
LSD_3 at	0.07	0.35

Different letters represent significant difference at p < .05 among various treatments. The same letter/letters represent no significant difference. CK: Control, COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar.; LSD1; Less significant differences between means of soil pH and EC at p=0.05 for tomato, LSD2; Less significant differences between means of soil properties at p=0.05 for Jew's mallow LSD3: comparison between soil pH and EC for Tomato and Jew's mallow.

The value of electrical conductivity (EC) is a soil parameter that indicates indirectly the total concentration of soluble salts and is a direct measurement of salinity. Among all treatments, the values of EC ranged from 1.36 to 2.87 dS/m in soil cultivated with tomatoes plants and from 0.83 to 1.22 dS/m in soil cultivated with Jew's mallow. The treatments had significant impact on soil EC at first experiment and there was no significant impact on soil EC at second experiment. EC values of the second experiment were lower than those of the first experiment. Differences in the EC values between treatments on the two experiments may be attributed to the differential metabolic work of the plant root exudates (extrusion of protons or organic acids). After harvest of Jew's mallow EC was decreased in Ck and organic amendment treatments this may be due to Jew's mallow tolerance to salinity. Similar findings was reported by El Moujabber *et al.* (2013) who reported that, to reduce the residual salinity, Jew's mallow was planted after tomato.

Treatments effect on plant growth and nutrient uptake

Organic amendments had a positive impact on the root and shoot fresh and dry weight of tomato plants (Figure 1). The addition of VCOM, VCOM-BC, COM, and COM-BC led to higher significant increases in fresh weight of shoots by 8.7, 5.5, 5.1, and 1.8 folds than the control soil, respectively. Similarly, the addition of VCOM, VCOM-BC, COM, and COM-BC led to higher significant increases in fresh weights of tomato roots by 17.1, 11.5, 7.7, and 1.6 folds than the control soil, respectively. The shoot dry weight of tomato plants increased significantly in soil treated with all organic amendments. The maximum dry matter (2.90 g/plant) was found in VCOM treatment followed by VCOM-BC treatment (2.27 g/plant), which was higher than control soil by 5.1 and 4 folds, respectively. The root dry weight of tomato plants increased significantly in soil treated with organic amendments (except for COM-BC), with the maximum root dry weight (1 g/plant) found in tomato plants grown in VCOM treatment followed by (0.98 g/plant) which was found in VCOM-BC.

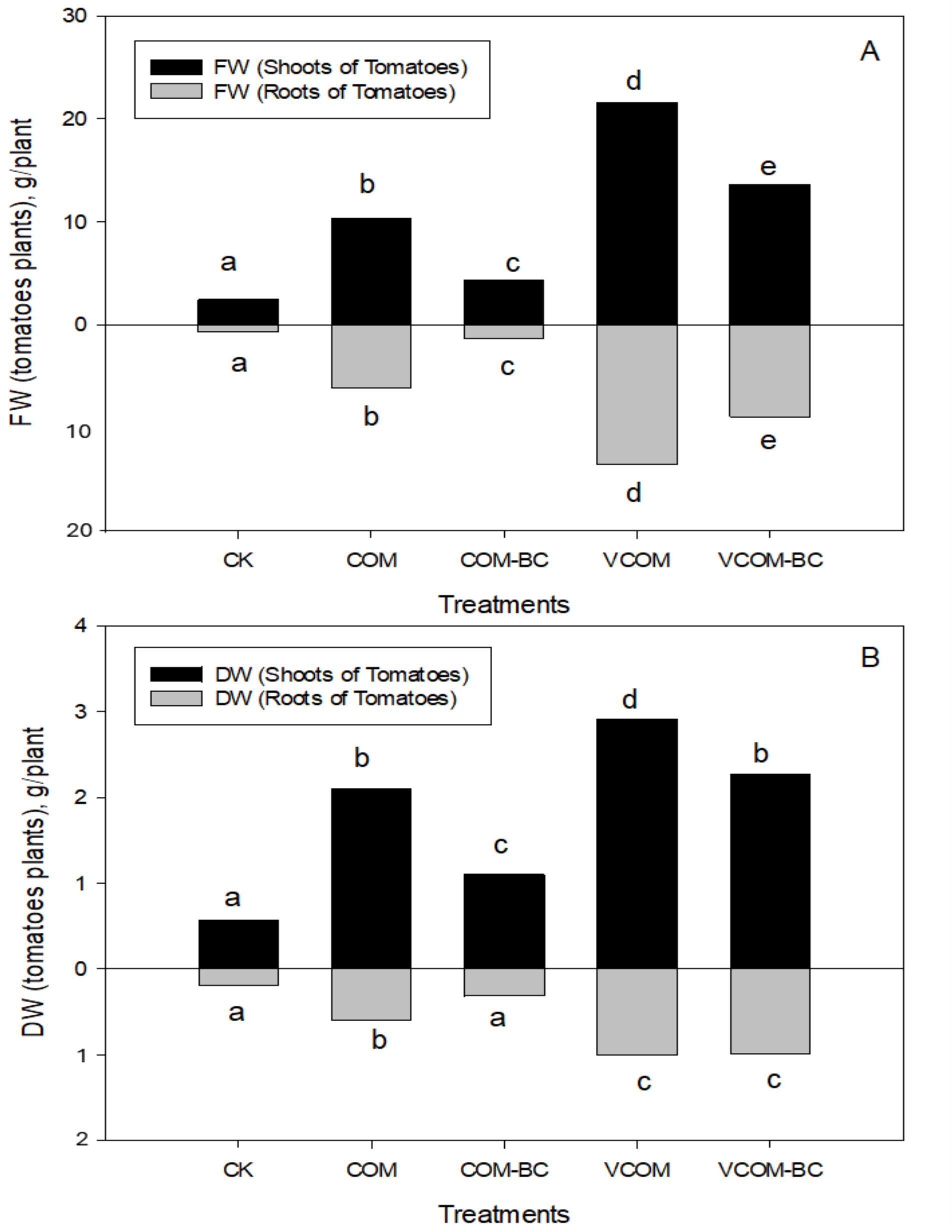

Figure 1. Treatments effect on fresh (A) and dry (B) biomass weight of shoots and roots of tomato plants; different letters represent significant differences at *p* < .05 among various treatments. The same letter/ letters represent no significant difference (±SD); CK: Control, COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar. All values represent the mean of fresh and dry biomass weight of shoots and roots, recorded 45 days after plantation.

For the residual effect, the application of organic amendments affected the fresh and dry weights of shoots and roots of Jew's mallow plants (Figure 2). The addition of organic amendments led to a significant increase in fresh weights of shoots and roots by 2.1and 2.8 folds, respectively compared with the control, with no significant effect between organic amendments in both shoots and roots fresh weights.

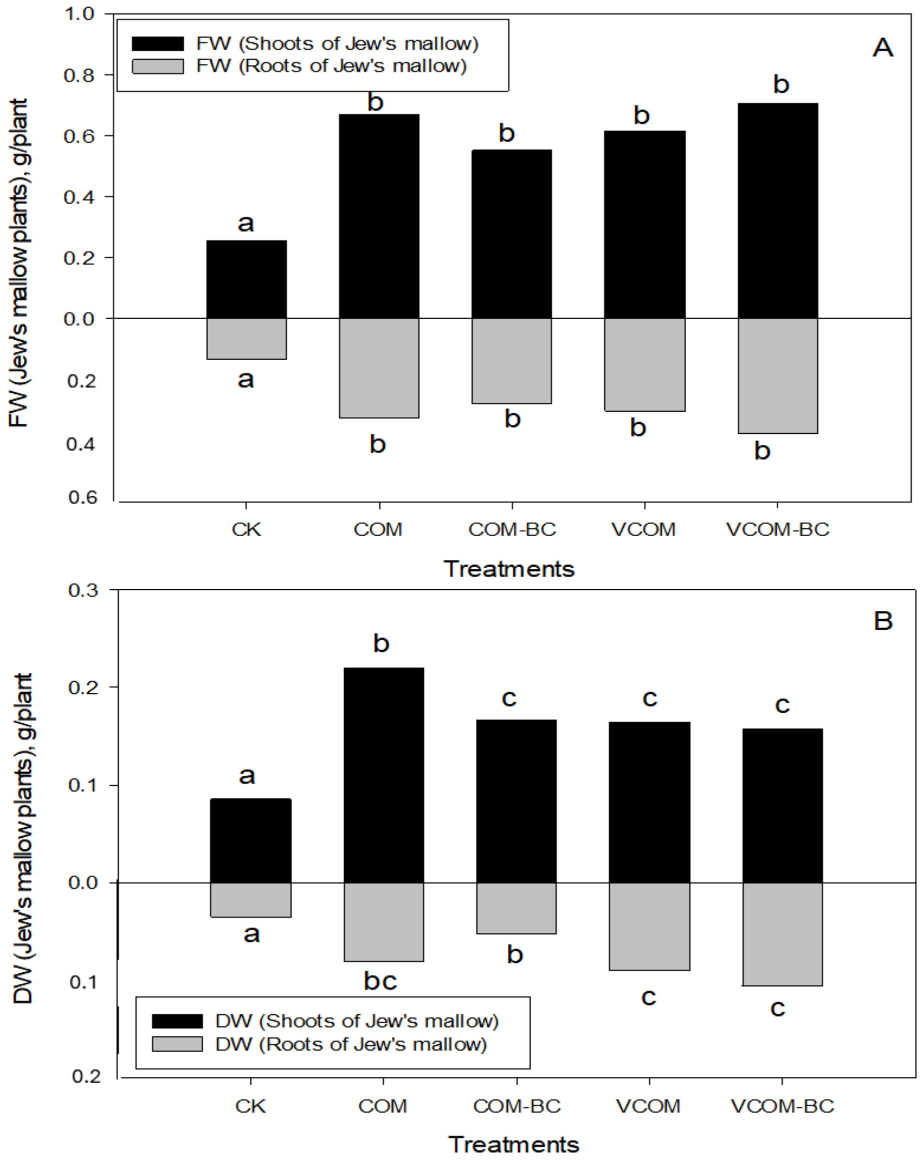

Fig. 2. Treatments effect on fresh (A), dry (B) biomass weight of shoots and roots of Jew's mallow plants; different letters represent significant differences at $p < .05$ among various treatments. The same letter/ letters represent no significant difference (±SD); CK: Control, COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar. All values represent the meaning of fresh and dry biomass weight of shoots and roots, recorded 45 days after plantation

The application of organic amendments led to a significantly higher increase in dry weights of shoots by 1.8-2.6 folds than the control soil. However, the application of organic amendments led to an increase in dry weights of roots by 1.5-3.0 folds, respectively compared to the control soil.

The results suggest that all investigated organic amendments enhanced the growth parameters of Tomato and Jew's Mallow plants. Organic amendments originating from plant or animal sources might possess numerous properties that increase soil fertility and boost crop productivity (Aytenew and Bore, 2020). Tomato plants performed better with VCOM and VCOM-BC than the other treatments in terms of plant development. Both macro and micronutrients are present in vermicompost, and the uptake of the nutrients has a positive effect on plant nutrition, leaves chlorophyll content growth, and photosynthesis (Rekha *et al*., 2018).

Throughout the vermicomposting process, plant growth hormones, symbiotic microorganisms, and other plant growth regulators are enhanced by humic acid, which positively affects plant growth when adding this vermicompost to the soil (Arancon *et al*., 2003). In a study conducted by Gong *et al*. (2021), the application of VCOM and VCOM-BC resulted in increased germination and the growth of tomato seedlings and the application of VCOM-BC showed higher plant growth compared to the application of biochar and vermicompost alone. Another study demonstrated that the application of vermicompost and biochar has frequently led to increases in root length, and biomass in the roots and shoots (Álvarez *et al*., 2017). Tasnim *et al.* (2021) investigated the application of vermicomposting with biochar on soil properties and crop yields. They suggested that 10% of the biochar addition enhanced the quality of vermicomposting, which can improve soil quality, both in terms of crop production and counteracting soil degradation effects.

Table 4. Treatments effect on nutrients concentrations and uptake by shoots and roots of tomato plants (First experiment).

Treatments	Nutrients concentrations (g/kg)			Nutrients uptake (mg plant^{-1})		
	N	P	K	N	P	K
Nutrients in shoots						
CK	46.10b	3.85b	7.80c	26.30c	2.19c	4.42d
COM	44.38bc	4.78ab	24.87ab	93.15a	9.69b	50.12b
COM-BC	55.48a	4.69ab	21.76b	60.99b	5.13c	23.20c
VCOM	41.51c	5.29a	30.02a	120.65a	15.45a	86.07a
VCOM-BC	43.38bc	4.29ab	9.22c	98.54a	9.65b	20.97c
LSD at p = .05	3.81	1.39	8.17	28.51	3.33	9.28
Nutrients in roots						
CK	19.90c	3.31b	3.16b	3.79c	0.61c	0.56c
COM	21.45c	5.68a	4.70a	11.68b	3.47b	2.75b
COM-BC	34.50a	5.44a	3.22b	10.86b	1.71c	1.01c
VCOM	22.87c	5.57a	5.58a	22.87a	5.47a	5.43a
VCOM-BC	28.21b	5.89a	3.57b	27.79a	5.60a	3.52b
LSD at p = .05	5.03	0.78	1.12	5.45	1.49	1.20

Different letters represent significant differences at p <0.05 among various treatments. The same letter/letters represent no significant difference. CK: Control, COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar

The effect of the treatments on plant nutrient concentration and uptake of tomato plants are shown in (Table 4). The results indicated that roots contained higher levels of P than shoots. It is possible that this element was more concentrated in plant roots than in plant shoots due to its precipitation on the root surface. Among all treatments, only COM-BC treatment increased significantly the concentration of shoot N. In addition, both COM-BC and VCOM-BC treatments increased significantly concentration of root N. However, all investigated treatments increased concentration of shoot and root P and the significant increase was with application of VCOM. All treatments had positive effect on increasing the concentration of shoot and root K. However, only VCOM followed by COM showed high significant increases in shoot and root K concentration.

For the treatment's effect on nutrient uptake, VCOM showed the highest increases in shoot N uptake by 4.6 folds compared to control, followed by VCOM-BC, COM, and COM-BC treatments, which led to higher significant increases in N uptake by 3.7, 3.5, and 2.3-fold than control. For organic amendments effect on root N uptake, VCOM-BC treatment led to highest increases of 7.3 folds compared to control, followed by VCOM, COM, and COM-BC treatments, which led to a significant increase in N uptake by 6.0, 3.1, and 2.9 folds compared to control, respectively. The treatments of VCOM, COM, and VCOM-BC led to significant increase in shoot P uptake respectively by 7.1, 4.4, and 4.4 folds and in roots by 9.0, 5.7, and 9.2 folds in root P uptake compared to control respectively. Additionally, the treatments of VCOM, COM, COM-BC and VCOM-BC led to a significant increase in shoot K uptake by 19.5, 11.3, 5.2, and 4.7 folds compared to control, respectively. For K uptake by roots, VCOM, VCOM-BC and COM treatments led to a significant increase of 9.7, 6.3, and 4.9 folds compared to the control, respectively.

For residual effect, results showed that the NPK concentrations and uptake were increased under the application of treatments as compared to NPK fertilizer treatment (control) in both roots and shoots as shown in (Table 5). The statistical analysis showed that the highest values of NPK content in Jews' mallow plants were obtained with applied VCOM-BC in both shoots and roots with significant differences compared to the control. Only VCOM-BC treatment led to a significant increase in N concentration by shoots and the treatments of COM-BC, VCOM and VCOM-BC led to a significant increase in N concentration by roots. All organic amendments led to significant increase in P concentration by shoots and roots. The treatments of COM, VCOM and VCOM-BC led to significant increase in shoot K concentration but there were no significant increases in root K concentration compared to control.

Table 5. The residual effect on nutrients concentrations and uptake by shoots and roots of Jew's mallow plants (Second experiment).

Treatments	nutrients concentrations (g/kg)			nutrients uptake (mg plant^{-1})		
	N	P	K	N	P	K
Nutrients in shoots						
CK	34.617b	3.626c	7.629d	2.916b	0.31b	0.65c
COM	35.433 b	4.42ab	26.624c	5.826ab	0.783a	4.856ab
COM-BC	36.927b	4.420ab	20.629d	5.853ab	0.70a	3.180b
VCOM	38.653ab	4.120ab	29.350b	6.870a	0.723a	5.806a
VCOM-BC	41.447 a	4.740a	38.07a	8.486a	0.890a	6.25a
LSD at p = 0.05	4.10	0.48	5.29	3.289	0.33	2.19
Nutrients in roots						
CK	23.973b	3.74b	4.38a	0.853c	0.13c	0.153b
COM	27.227ab	4.56a	4.738a	1.596bc	0.243bc	0.250ab
COM-BC	28.693a	4.41a	4.984a	2.49ab	0.430a	0.443ab
VCOM	30.353a	4.526a	4.914a	2.506ab	0.360ab	0.463ab
VCOM-BC	30.670a	4.74a	5.513a	3.0467a	0.463a	0.553a
LSD at p = .05	4.03	0.47	2.10	1.07	0.12	0.32

Different letters represent significant differences at p < 0.05 among various treatments. The same letter/letters represent no significant difference. CK: Control, COM: Compost, COM-BC: Composted biochar compost, VCOM: Vermicompost, VCOM-BC: Vermi-biochar

For nutrients uptake, VCOM and VCOM-BC showed significant increase in shoot N uptake by 2.36 and 2.91-fold compared to control, respectively. For root N uptake, the treatments of COM-BC, VCOM, and VCOM-BC recorded significant increases by 2.9, 3.0, and 3.6 compared to control, respectively. All organic amendments led to significant increase in P uptake by shoots and roots (except for COM treatment with root P uptake). Additionally, all organic amendments led to a significant increase in K uptake by shoots compared to control meanwhile, only VCOM-BC treatment led to a significant increase in K uptake by roots by 3.6-fold compared to control. Organic amendments are rich in organic matter and essential nutrients for plants such as nitrogen, phosphorus, and potassium, fulfilling the nutrient deficiency in sandy soils. The addition of organic amendments increases the levels of OM in the soil, stimulating the activity of soil microorganisms, which transform nutrients into forms that plants can easily absorb (Irin and Hasanuzzaman, 2024).

Regarding the positive effect of vermicompost on nutrient content in plant tissues, the results are in harmony with those reported by (Chaoui *et al*., 2003), who demonstrated that vermicomposting is an excellent way to obtain readily available P, K, and N. Vermicomposting with biochar (VCOM-BC) showed the highest increases in NPK content of plant tissues for Jew's mallow plants at the second season. Numerous researchers have examined the potential of using biochar to compost and vermicompost biowastes (Khan *et al*., 2019). In a study conducted by Wu *et al*. (2023) to optimize biochar addition for vermicomposting, they found that biochar addition promoted the quality of final vermicompost. Khan *et al*. (2020) demonstrated that biochar and earthworm could jointly increase the concentration of important plant nutrients in the finished vermicompost.

Table 6. Correlation between measured parameters and their effect on tomato growth.

Indices	pH	EC	SFW	RFW	SDW	RDW	N uptake shoot	N uptake root	P uptake shoot	P uptake root	K uptake shoot	K uptake root
Ph	1											
EC	-0.0101	1										
SFW	0.0670	0.1061	1									
RFW	0.1401	0.1418	0.9499*	1								
SDW	0.0435	0.2300	0.9753*	0.9332*	1							
RDW	-0.0025	0.1170	0.8689*	0.8933*	0.8875*	1						
N uptake shoot	0.0774	0.3498	0.9415*	0.8847*	0.9849*	0.8341*	1					
N uptake root	0.1534	0.2903	0.7459*	0.7843*	0.7835*	0.8816*	0.7691*	1				
P uptake shoot	0.0153	0.2396	0.9284*	0.9139*	0.9387*	0.8499*	0.9106*	0.7502*	1			
P uptake root	-0.0643	0.1660	0.8811*	0.8876*	0.9063*	0.9803*	0.8603*	0.8874*	0.8334*	1		
K uptake shoot	-0.0711	0.2365	0.8373*	0.7945*	0.7850*	0.5630*	0.7651*	0.4340	0.8496*	0.5889*	1	
K uptake root	-0.0306	0.0772	0.9572*	0.9456*	0.9256*	0.9162*	0.8627*	0.7668*	0.90356*	0.9315*	0.8044*	1

(*) Means significant at 0.05

Table 7. Correlation between measured parameters and their effect on Jew's mallow growth.

Indices	Ph	EC	SFW	RFW	SDW	RDW	N uptake shoot	N uptake root	P uptake shoot	P uptake root	K uptake shoot	K uptake root
Ph	1											
EC	-0.3334	1										
SFW	-0.5992	-0.0382	1									
RFW	-0.4853	-0.0827	0.9396*	1								
SDW	-0.0934	-0.2628	0.2645	0.3871	1							
RDW	-0.2890	-0.1341	0.8094*	0.8695*	0.3527	1						
N uptake shoot	-0.0639	-0.3401	0.2359	0.3506	0.9853*	0.2817	1					
N uptake root	-0.3508	-0.1486	0.8457*	0.8924*	0.3851	0.9863*	0.3257	1				
P uptake shoot	-0.0873	-0.3661	0.3051	0.4281	0.9673*	0.3762	0.9719*	0.4060	1			
P uptake root	-0.2610	-0.2134	0.7739*	0.8315*	0.4232	0.9852*	0.3559	0.9662*	0.46166	1		
K uptake shoot	-0.2484	-0.3569	0.4365	0.4713	0.8364*	0.4152	0.8121*	0.4352	0.8492*	0.5065*	1	
K uptake root	-0.4548	0.0191	0.8250*	0.8998*	0.3552	0.9038*	0.2832	0.9099*	0.3096	0.8516*	0.4118	1

(*) Means significant at 0.05

Correlation between tomato and Jew's mallow growth and nutrient uptake was established (Table 6 and 7). The relationship revealed a significant correlation between tomato and jew's mallow growth parameters (shoot fresh weight (SFW), root fresh weight (RFW), shoot dry weight (SDW), root dry weight (RDW), and nutrients uptake (r=0.5630 and 0.9849). According to our findings, the application of organic amendments could optimize nutrient uptake and plant growth and thus help sustain in the calcareous sandy soil.

Conclusion

The results showed that nutrient uptake and plant growth can be effectively improved by applied organic amendments. Overall, plants treated with VCOM-BC showed the greatest improvements in nutrient uptake through the roots and shoots. In most cases, VCOM and/or VCOM-BC showed the highest increases in nutrient (NPK) uptake. Therefore, our results suggest that the prepared organic amendments (especially vermicompost and biochar-amended vermicompost) have the potential to optimize nutrient uptake and plant growth and thus, help sustain in the calcareous sandy soil. However, further research on the interactions between vermicompost and biochar is required.

References

Álvarez, J. M., Pasian, C., Lal, R., López Núñez, R., and Fernández Martínez, M. (2017). Vermicompost and biochar as substitutes of growing media in ornamental-plant production. Journal of Applied Horticulture 19 (03): 205-214, doi.org/10.37855/jah.2017.v19i03.37

Arancon, N. Q., Lee, S., Edwards, C. A., and Atiyeh, R. (2003). Effects of humic acids derived from cattle, food and paper-waste vermicomposts on growth of greenhouse plants. Pedobiologia, 47(5-6): 741-744, *doi.org/10.1078/0031-4056-00253*

Arora, D. S., and Kaur, N. (2019). Antimicrobial potential of fungal endophytes from *Moringa oleifera*. Applied Biochemistry and Biotechnology, 187: 628-648. doi.org/10.1007/s12010-018-2770-y

Awasthi, M. K., Duan, Y., Awasthi, S. K., Liu, T., and Zhang, Z. (2020). Influence of bamboo biochar on mitigating greenhouse gas emissions and nitrogen loss during poultry manure composting. Bioresource technology, 303: 122-952, doi.org/10.1016/j.biortech.2020.122952

Aytenew, M., and Bore, G. (2020). Effects of organic amendments on soil fertility and environmental quality: A review. Plant Sci, 8: 112-119, doi.org/10.11648/j.jps.20200805.12

Biabani, A., Carpenter-Boggs, L., Gholizadeh, A., Vafaie-Tabar, M., and Omara, M. O. (2018). Reproduction efficiency of *Eisenia foetida* and substrate changes during vermicomposting of organic materials. Compost Science & Utilization. 26: 209-215, doi.org/10.1080/1065657X.2018.1463877

Cao, Y., Tian, Y., Wu, Q., Li, J., and Zhu, H. (2021). Vermicomposting of livestock manure as affected by carbon-rich additives (straw, biochar and nanocarbon): a comprehensive evaluation of earthworm performance, microbial activities, metabolic functions and vermicompost quality. Bioresource Technology. 320:124404, doi.org/10.1016/j.biortech.2020.124404

Chaoui, H. I., Zibilske, L. M., and Ohno, T. (2003). Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. Soil Biology and Biochemistry. 35: 295-302, doi.org/10.1016/S0038-0717(02)00279-1

Chowdhury, M. A., de Neergaard, A., and Jensen, L. S. (2014). Potential of aeration flow rate and bio-char addition to reduce greenhouse gas and ammonia emissions during manure composting. Chemosphere. 97: 16-25, doi.org/10.1016/j.chemosphere.2013.10.030

Doan, T. T., Ngo, P. T., Rumpel, C., Van Nguyen, B., and Jouquet, P. (2013). Interactions between compost, vermicompost and earthworms influence plant growth and yield: A one-year greenhouse experiment. Scientia Horticulturae. 160: 148-154, doi.org/10.1016/j.scienta.2013.05.042

Domínguez, J. (2004). State-of-the-Art and New Perspectives on Vermicomposting Research (pp.401–424). CRC Press. https://doi.org/10.1201/9781420039719.CH20

El-Hady, O.. and Abo-Sedera, S. (2006). Conditioning effect of composts and acrylamide hydrogels on a sandy calcareous soil. II-Physico-bio-chemical properties of the soil. Int. J. Agri. Biol. 8: 876-884.

El Moujabber, M., Atallah, T., Bou Samra, B., Fayssal, S., El Chami, D., and Darwish, T. (2013). Seawater intrusion and crop response to salinity in coastal Lebanon. Lebanese Science Journal. 14:119-128.

Fu, X., Huang, K., Chen, X., Li, F., and Cui, G. (2015). Feasibility of vermistabilization for fresh pelletized dewatered sludge with earthworms *Bimastus parvus.* Bioresource Technology. 175: 646-650, https://doi.org/10.1016/j.biortech.2014.11.007

Gong, X., Zhang, Z., and Wang, H. (2021). Effects of Gleditsia sinensis pod powder, coconut shell biochar and rice husk biochar as additives on bacterial communities and compost quality during vermicomposting of pig manure and wheat straw. Journal of Environmental Management. 295:113136, https://doi.org/10.1016/j.jenvman.2021.113136

Hua, L., Wu, W., Liu, Y., McBride, M. B., and Chen, Y. (2009). Reduction of nitrogen loss and Cu and Zn mobility during sludge composting with bamboo charcoal amendment. Environmental Science and Pollution Research. 16: 1-9, https://doi.org/10.1007/s11356-008-0041-0

Huang, K., Guan, M., Chen, J., Xu, J., Xia, H., and Li, Y. (2022). Biochars modify the degradation pathways of dewatered sludge by regulating active microorganisms during gut digestion of earthworms. Science of The Total Environment. 828: 154496, https://doi.org/10.1016/j.scitotenv.2022.154496

Irin, I. J., and Hasanuzzaman, M. (2024). Organic amendments: Enhancing plant tolerance to salinity and metal stress for improved agricultural productivity. Stresses. 4: 185-209, https://doi.org/10.3390/stresses4010011

Jackson, M. (1973). Soil Chemical Analysis. Prentice hall of India private limited. New Delhi, 498.

Jones, J., Wolf, B., and Mills, H. (1991). Plant Analysis Handbook, Micro, Macro, Publishing Inc. Georgia, USA.

Joseph, P. V. (2019). Efficacy of different substrates on vermicompost production: A biochemical analysis. *In*: Marcelo Larramendy and Sonia Soloneski (Eds.) Organic Fertilizers-History, Production and Applications. Intech Open Limited, London, UK. doi.org/10.5772/intechopen.86187

Khan, M. B., Cui, X., Jilani, G., Lazzat, U., Zehra, A., Hamid, Y., Hussain, B., Tang, L., Yang, X., and He, Z. (2019). Eisenia fetida and biochar synergistically alleviate the heavy metals content during valorization of biosolids via enhancing vermicompost quality. Science of the Total Environment. 684: 597-609, https://doi.org/10.1016/j.scitotenv.2019.05.370

Khan, M. B., Cui, X., Jilani, G., Tang, L., Lu, M., Cao, X., Sahito, Z. A., Hamid, Y., Hussain, B., and Yang, X. (2020). New insight into the impact of biochar during vermi-stabilization of divergent biowastes: Literature synthesis and research pursuits. Chemosphere. 238: 124679, https://doi.org/10.1016/j.chemosphere.2019.124679

Khan, N., Clark, I., Sánchez-Monedero, M. A., Shea, S., Meier, S., and Bolan, N. (2014). Maturity indices in co-composting of chicken manure and sawdust with biochar. Bioresource technology. 168: 245-251, https://doi.org/10.1016/j.biortech.2014.02.123

Lao, M., Jiménez, S., Eymar, E., Fernández, E., and Jiménez, R. (2003). Determination of spatial variability of nutrient composition of soil solutions in greenhouses by using suction cups. Communications in Soil Science and Plant Analysis. 34: 865-879, https://doi.org/10.1081/CSS-120018980

Leege, P. B. (1998). Introduction of test methods for the examination of composting and compost. *In*: Brown, S., Angle, J.S., Jacobs, L. (eds.) Beneficial Co-Utilization of Agricultural, Municipal and Industrial By-products. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-5068-2_22

Liu, X., Zhang, J., Wang, Q., Chang, T., Shaghaleh, H., and Hamoud, Y. A. (2022). Improvement of photosynthesis by biochar and vermicompost to enhance tomato (*Solanum lycopersicum L.)* yield under greenhouse conditions. Plants. 11(23): 3214, https://doi.org/10.3390/plants11233214

Lv, B., Cui, Y., Wei, H., Chen, Q., and Zhang, D. (2020). Elucidating the role of earthworms in N_2O emission and production pathway during vermicomposting of sewage sludge and rice straw. Journal of Hazardous Materials. 400: 123215, https://doi.org/10.1016/j.jhazmat.2020.123215

Mahaly, M., Senthilkumar, A. K., Arumugam, S., Kaliyaperumal, C., and Karupannan, N. (2018). Vermicomposting of distillery sludge waste with tea leaf residues. Sustainable Environment Research. 28: 223-227, https://doi.org/10.1016/j.serj.2018.02.002

Meshram, N., Singare, P., and Kausadikar, H. J. A. (2023). Calcareous soils and their management. Agriculture. 3(4): 1-6

Moldes, A., Cendon, Y., and Barral, M. (2007). Evaluation of municipal solid waste compost as a plant growing media component, by applying mixture design. Bioresource technology. 98: 3069-3075, https://doi.org/10.1016/j.biortech.2006.10.021

Neilsen, G., Hogue, E., Neilsen, D., and Zebarth, B. (1998). Evaluation of organic wastes as soil amendments for cultivation of carrot and chard on irrigated sandy soils. Canadian Journal of Soil Science. 78: 217-225, https://doi.org/10.4141/S97-037

Oyege, I., and Balaji Bhaskar, M. S. (2023). Effects of vermicompost on soil and plant health and promoting sustainable agriculture. Soil Systems. 7: 101, http://dx.doi.org/10.3390/soilsystems7040101

Pandey, D., Daverey, A., and Arunachalam, K. (2020). Biochar: Production, properties and emerging role as a support for enzyme immobilization. Journal of Cleaner Production. 255: 120267. doi.org/10.1016/j.jclepro.2020.120267

Phares, C. A., and Akaba, S. (2022). Co-application of compost or inorganic NPK fertilizer with biochar influences soil quality, grain yield and net income of rice. Journal of Integrative Agriculture. 21: 3600-3610, https://doi.org/10.1016/j.jia.2022.07.041

Picca, G., Plaza, C., Madejón, E., and Panettieri, M. (2023). Compositing of coffee silverskin with carbon rich materials leads to high quality soil amendments. Waste and Biomass Valorization. 14: 297-307, https://doi.org/10.1007%2Fs12649-022-01879-7

Prost, K., Borchard, N., Siemens, J., Kautz, T., Séquaris, J. M., Möller, A., and Amelung, W. (2013). Biochar affected by composting with farmyard manure. Journal of Environmental Quality, 42: 164-172, http://dx.doi.org/10.2134/jeq2012.0064

Rekha, G. S., Kaleena, P. K., Elumalai, D., Srikumaran, M. P., and Maheswari, V. N. (2018). Effects of vermicompost and plant growth enhancers on the exo-morphological features of *Capsicum annum* (Linn.) Hepper. International Journal of Recycling of Organic Waste in Agriculture. 7: 83-88, https://doi.org/10.1007/s40093-017-0191-5

Sánchez-García, M., Alburquerque, J. A., Sánchez-Monedero, M. A., Roig, A., and Cayuela, M. L. (2015). Biochar accelerates organic matter degradation and enhances N mineralisation during composting of poultry manure without a relevant impact on gas emissions. Bioresource technology. 192: 272-279, https://doi.org/10.1016/j.biortech.2015.05.003

Schlichting, E., Blume, H.-P., and Stahr, K. (1995). Pareys Studientexte: Bodenkundliches Praktikum: eine Einführung in pedologisches Arbeiten für Ökologen, insbesondere Land-und Forstwirte, und für Geowissenschaftler, Blackwell. Bodenkundliches Praktikum. Blackwell Wissenschaftsverlag, Berlin, https://doi.org/10.1002/jpln.1996.3581590315

Sharma, K., and Garg, V. (2018). Comparative analysis of vermicompost quality produced from rice straw and paper waste employing earthworm *Eisenia fetida* (Sav.). Bioresource technology. 250: 708-715, https://doi.org/10.1016/j.biortech.2017.11.101

Singh, J., Kaur, A., and Vig, A. P. (2014). Bioremediation of distillery sludge into soil-enriching material through vermicomposting with the help of *Eisenia fetida*. Applied Biochemistry and Biotechnology. 174: 1403-1419, https://doi.org/10.1007/s12010-014-1116-7

Soobhany, N., Mohee, R., and Garg, V. K. (2015). Experimental process monitoring and potential of *Eudrilus eugeniae* in the vermicomposting of organic solid waste in Mauritius. Ecological Engineering. 84: 149-158, https://doi.org/10.1016/J.ECOLENG.2015.08.003

Tasnim, U. F., Shammi, M., and Uddin, M. K. (2021). Effect of biochar amended vermicomposting of food and beverage industry sludge along with cow dung and seed germination bioassay. Pollution. 7: 355-365, https://doi.org/10.22059/poll.2021.315530.961

Walker, D. J., Clemente, R., Roig, A., and Bernal, M. P. (2003). The effects of soil amendments on heavy metal bioavailability in two contaminated Mediterranean soils. Environmental Pollution. 122: 303-312, https://doi.org/10.1016/S0269-7491(02)00287-7

Weyers, S. L., and Spokas, K. A. (2011). Impact of biochar on earthworm populations: a review. Applied and Environmental Soil Science. 2011: 541592, https://doi.org/10.1155/2011/541592

Wu, S. C., Cao, Z., Li, Z., Cheung, K., and Wong, M. H. (2005). Effects of biofertilizer containing N-fixer, P and K solubilizers and AM fungi on maize growth: A greenhouse trial. Geoderma. 125: 155-166, https://doi.org/10.1016/j.geoderma.2004.07.003

Wu, Y., Li, Q., Zheng, Y., *Xiong, X., Chen, Y., Shaaban, M., and Hu, R.(2023)*. Optimizing biochar addition for vermicomposting: A comprehensive evaluation of earthworms' activity, N_2O emissions and compost quality. Biochar. 5(2023). https://doi.org/10.1007/s42773-022-00203-9

دور الكمبوست والكمبوست الدودي مع الفحم الحيوي في إمتصاص المغذيات ونمو نباتات الطماطم والملوخية المزروعة في التربة الرملية الجيرية

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الملخص

تم إجراء تجربة أصص بقسم الأراضي والمياه، كلية الزراعة، جامعة أسيوط لدراسة دور الكمبوست والكمبوست الدودي المنتج في وجود الفحم الحيوي لتحسين خصائص التربة وامتصاص المغذيات ونمو نباتات الطماطم (*Solanum lycopersicum L*) وكذلك دراسة الأثر المتبقي للمعاملات على نمو نباتات الملوخية

(*Corchorus Olitorius L*) حيث تم إجراء خمس معاملات وهي:

الكمبوست، الكمبوست في وجود الفحم الحيوي، الكمبوست الدودي، اكمبوست الدودي في وجود الفحم الحيوي، معاملة الكنترول

وقد أظهرت النتائج أن المحسنات العضوية لها تأثير إيجابي علي كلا من الوزن الرطب والجاف للمجموع الخضري والجذري لنباتات الطماطم، حيث وجد أقصي وزن للمادة الجافة (2.90جم/نبات) في معاملة الكمبوست الدودي تليها معاملة الكمبوست الدودي في وجود الفحم الحيوي (2.27 جرام/ نبات) والتي كانت اعلي من التربة الكنترول بمقدار 5.1 و 4 أضعاف علي التوالي. كذلك وجد أن معاملة التربة بالمحسنات العضوية فيما عدا معامله الكمبوست في وجود الفحم الحيوي أدت إلي زيادة معنوية في الوزن الجاف للجذور في نباتات الطماطم، حيث وجد أقصي وزن جاف للجذور في نباتات الطماطم النامية في التربة المعاملة بالكمبوست الدودي تليها التربة المعاملة بالكمبوست الدودي في وجود الفحم الحيوي.

كما اظهرت النتائج أن استخدام المحسنات العضوية أدي الي زيادة معنوية في الاوزان الرطبه والجافة للمجموع الخضري والجذري لنباتات الملوخيه مقارنة بالتربة الكنترول. في معظم الحالات أظهر كلا من الكمبوست الدودي والكمبوست الدودي في وجود الفحم الحيوي أعلي زيادة في إمتصاص عناصر النيتروجين والفوسفور والبوتاسيوم.

وأظهرت النتائج أن تطبيق الكمبوست الدودي والكمبوست الدودي في وجود الفحم الحيوي يمكن أن تكون استراتيجيه فعالة لادارة المغذيات لنمو نباتات الطماطم والملوخية في الأراضي الجيرية المصرية المستصلحة حديثا.

الكلمات الرئيسية: *حالة التغذية ، الفحم الحيوي, الكمبوست الدودي والتربة القاحلة، محسنات التربة.*