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Efficiency of Some Natural Substitutes of Peatmoss as Growing Media for Tomato Seedlings Production

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Abstract: A greenhouse trail was conducted to evaluate the efficiency of some types of prepared compost as growing media for tomato seedling production. Four types of compost were prepared by composting rice straw (RS), poultry manure (PM) and banana wastes (BW)as ground materials. The prepared growing media were derived by composting the above raw wastes pile compost mixtures (comp. mix. No. 1), and the other three piles with some additional materials i.e. microbial inoculation (comp. mix. No. 2), microbial inoculation + rock phosphate + feldspar (comp. mix. No. 3) and tea compost (compost mix. No. 4). The four compost mixtures along with peat moss (control) were subjected to either compost washing or unwashing, to compost enriched with nutrients or no and to compost mixing with either vermiculite or sand (ratio of 1:1 for both materials), comprising 54 treatments. Tomato seeds were sown on those growing media for 45 days. The fresh and dry weights of the growing seedlings as well as macro and micro nutrients uptake were determined. The obtained results could be briefly summarized in the following: **Effect of compost type (A):** The highest values of fresh and dry weights of tomato seedlings as well as macro (N, P and K) and micronutrients (Fe, Mn. Zn and Cu)uptake were recorded under growing media of peat moss (control) and compost type No. 4 (RS+BW+PM + tea compost). **Effect of mixing components (B):** The values of fresh and dry weights and N, P, K, Fe, Mn, Zn and Cu uptake by tomato seedlings were significantly higher when mixing component of 50 % vermiculite + 50% compost or peat moss was added than both (50% sand + 50 % compost) and 100 % compost or peat moss.
Effect of nutrients enrichment (C): The non-enriched treatments gave significantly higher values of fresh and dry weights of tomato seedlings as well as N, p, K, Fe, Mn, Zn and Cu uptake as compared with those enriched treatments. Moreover, the enriched peatmoss (control) gave significantly higher values of macro and micronutrients uptake by tomato seedlings as compared with those non-enriched treatments. **Washing effect (D):** All the compost types which were subjected to washing gave significantly higher increases in fresh and dry weights of tomato seedlings as well as macro and micro nutrients uptake than those treatments which were not washed. **Effect of interaction between A and B:** The interaction between the compost mixture (A) and mixing component (B) significantly affected all the parameters under study i.e. fresh and dry weights of tomato seedlings as well as N, P, K, Fe, Mn, Zn and Cu uptake. The highest significant values of fresh and dry weights of tomato seedlings were obtained by using compost mixture No.1 and mixing component of 50% vermiculite +50%compost or peat moss. The highest values of N, P, K, Fe, Zn and Cu were found when the compost mixture No.3 and the mixing component 50% vermiculite +50% compost or peat moss were used, while the highest values of Mn uptake were found under compost mixture No.4 and the same mixing component. **Effect of interaction between A and C:** The highest significant values of fresh and dry weights as well as N, P, K, Fe, Mn and Zn uptake by tomato seedlings were found under non-enriched treatments and using compost mixture No. 4, while the highest values of Cu uptake were found under non-enriched treatments and compost mixture No. 3. **Effect of interaction between B and C:** The highest significant values of fresh and dry weights as well as N,

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P, K, Fe, Mn, Zn and Cu uptake by tomato seedlings were found when the mixing component of 50% vermiculite + 50% compost or peat moss and non-enriched treatments were used. The lowest values of fresh and dry weights as well as N uptake by tomato seedlings were found under mixing components of 100 % compost or peat moss and enriched treatments. Moreover, the lowest values of Fe, Mn, Zn and Cu uptake by tomato seedlings were obtained by using 50% sand + 50% compost or peat moss under non-enriched treatments. **Effect of interaction between A, B,C and D:** The interaction between the main factors of A, B, C and D, significantly affect the fresh and dry weights as well as all the studied macro and micro nutrients uptake by tomato seedlings. The highest values of fresh and dry weights as well as N, p and K uptake by tomato seedlings were found under non-enriched, washing treatments and using compost mixture No. 4 and mixing component of 50 % vermiculite + 50 % compost or peat moss. The highest values of Fe and Mn uptake by tomato seedlings were found when non-enriched and washed treatments, the mixing component of 50% vermiculite + 50% compost or peat moss and compost mixture No.1 were used, while the highest values of Zn and Cu were attained when non-enriched and washed treatments, mixing component of 50% vermiculite + 50% compost or peat moss and compost mix. No. 3 were used.

Key words: Compost, microbial inoculation, growing media, nutrients enrichment.

INTRODUCTION

Nowadays peat moss, represents a major source of organic matter used in formulating growing media for different plant seedlings. In spit of its high cost, Egypt imports high amounts of such substrate. Accordingly it seems more economic if we could find out some local and efficient substitutes of peat moss for this purpose. The local production of such materials particularly, if they were efficient and dependent essentially on the natural and local resources do not only saves a part of the national income but also leads to reduction of the environmental pollution and found out suitable jobs for many labors hands. Moreover, organic residues in peat moss preparation is considered as one of the most suitable media for production of plant seedlings. The preparation of peat moss needs individual organic materials mixed with some other materials such as bentonite and/or sand in different ratios.

Supplementation of raw materials with natural rocks (such as rock phosphate and feldspar) and microbial inoculants (such as *Trichoderma viridie*, or *Streptomyces aurcofaciens*, *Aspergillus awanori*, *Polyporus veriscoler*, *Phanerochaete chrysosporium* and *Azotobacter chroococcum*) developed a new technology for the production of rapid compost with good quality (Biswa and Narayanasamy, 2002).

Several authors reported that compost application to growing media can improve their physical and chemical properties as well as increasing the availability of macro and micronutrients needed for seedlings to be grown (Hellal *et al*., 1996, Ozores-Hampton *et al*., 1998 and Abdallah *et al*., 2000).

The present work was conducted to evaluate the suitability and efficiency of some prepared types of compost as media for growing tomato seedlings under green house conditions.

MATERIALS AND METHODS

This experiment was conducted to evaluate the suitability of some prepared types of compost mixtures, as media for growing tomato seedlings under green house conditions. The experiment was undertaken in The Protected Cultivation, Ministry of Agriculture, Dokki, Giza.

Four types of compost were represented by four compost piles, all of which were prepared by composting rice straw (RS), banana wastes (BW) and poultry manure (PM) as a ground materials. The growing media were prepared by composting the above raw ground wastes (Pile or compost mixture No.1). The other three piles were treated with some additional materials i.e. microbial inoculation (pile 2), microbial inoculation + 5kg from each of rock phosphate and feldspar (pile 3) and tea compost (pile 4). The four types of compost along with the peat moss as a control treatment, were subjected to either washed or not, enriched (enrichment with nutrients) or not and mixed with either vermiculite or sand at volumetric ratio (1:1) for both mixtures, comprising 54 treatments (Table 1 and 2). The composting process was conducted as described by Allam (2005).

Table 1: Types and amounts of agricultural wastes, additive materials and inoculums used for building the different compost piles under study.

Raw materials amounts comprising the pile	Pile Comp. Mix			
Agricultural wastes				
Rice straw (RS) 50 kg	1	2	3	4
Poultry manure (PM) 100 kg				
Banana wastes (BW) 50 kg	Basic materials used for building up all the compost piles			
Additive materials:				
Phosphate rocks (5kg)	-	-	+	-
Feldspar (5kg)	-	-	+	-
Microbial inoculation:				
Trichoderma harizium (1%)	-	+	+	-
Phanerochaet chrysosporium (1%)	-	+	+	-
Compost tea (20 L)	-	-	-	+

Table 2: Experimental design evaluation of prepared compost types as media for tomato seedling growth

Treatment No.	Treatments	Mixing ratio V/V	Treatment No.	Treatments	Mixing ratio V/V
1	P	100%			
2	P+V	50:50			
3	P + S	50:50			
4	Unw. Comp. Mix. (1)	100%	16	W. Comp. Mix. (1)	100%
5	Unw. Comp.Mix. (1) + V	50:50	17	W. Comp. Mix. (1) + V	50:50
6	Unw. Comp.Mix. (1) + S	50:50	18	W. Comp.Mix. (1) + S	50:50
7	Unw. Comp.Mix. (2)	100%	19	W. Comp.Mix. (2)	100%
8	Unw. Comp.Mix. (2) + V	50:50	20	W. Comp.Mix. (2) + V	50:50
9	Unw. Comp.Mix. (2) + S	50:50	21	W. Comp.Mix. (2) + S	50:50
10	Unw. Comp.Mix. (3)	100%	22	W. Comp.Mix. (3)	100%
11	Unw. Comp.Mix. (3) + V	50:50	23	W. Comp.Mix. (3) + V	50:50
12	Unw. Comp.Mix. (3) + S	50:50	24	W. Comp.Mix. (3) + S	50:50
13	Unw. Comp.Mix. (4)	100%	25	W. Comp.Mix. (4)	100%
14	Unw. Comp.Mix. (4) + V	50:50	26	W. Comp.Mix. (4) + V	50:50
15	Unw. Comp.Mix. (4) + S	50:50	27	W. Comp.Mix. (4) + S	50:50

These (27) treatments (Table 2) were subjected to nutrients enrichment or not comprise 54 as total used treatments:
P = Peat moss , V = vermiculite, S= sand, Unw. = unwashed, W. = washed, RS= Rice straw, BW = Banana wastes, PM = Poultry manure.
Comp.Mix. 1 = (RS + BW + PM).
Comp.Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp.Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Tomato seeds of cv. Castal rock var. (*Lycopersicom esculentum*) were sown on those growing media for 45 days. Nutrient solutions (per 50 kg growth media) were used and prepared from: Ammonium nitrate 250 g, potassium sulphate 50 g, magnesium sulphate 50 g, copper phosphate 400 g, Tobcin 50 g; Kristalon 75 g and calcium carbonate 400 g.

The fresh and dry weights of tomato seedlings from each treatment were recorded after 45 days from sowing. Total N in seedlings were determined by the kjeldhal method described by Bremener and Mulvaney (1982). Phosphorous, potassium, Fe, Mn, Zn and Cu were determined according to the method described by Cottenie *et al.* (1982).

Analysis variances of the obtained data were performed as recommended by Snedecor and Cochran (1980) and significant differences among the means of various treatments were established using Duncan and multiple range tests according to Waller and Duncan (1969).

RESULTS AND DISCUSSIONS

To evaluate the efficiency of prepared compost types as growing media for tomato seedlings, a green house trial was undertaken.

Fresh and Dry Weights of Tomato Seedlings:

Effect of Main Factors:

This study includes four main factors i.e. compost types (A), mixed components (B), nutrients enrichment (C) and washing (D).

Effect of Compost Type (A):

Peat moss (P) as well as the four prepared compost types were evaluated as growing media for tomato seedlings.

Irrespective of the effect of mixed components (B), nutrients enrichment (C) and washing effect (D), the effects of compost type (A) on fresh and dry weights of tomato seedlings grown for 45 days are presented in Table (3). Data reveal that all the prepared compost types positively and significantly affected both fresh and dry weights of tomato seedlings. Using the compost mix. No. 4 (RS + BW + PM + tea compost) significantly increased both fresh and dry weights of tomato seedlings which averaged 2.37 g/seedling for fresh and 223.45 mg/seedling for dry weights, respectively, when compared with all the other compost mixs. under study (No. 1, 2 and 3) including the imported peat moss (control). However, the imported peat moss (control) significantly increased both fresh and dry weights of tomato seedlings more than the compost types (mixs of No. 1, 2 and 3). This result may be due to the special characteristics of the imported peat moss i.e. as pH (1:10) 4.15, EC (1:10) 0.144 dS/m, OM 94.71 %, WHC, 403.50 % and CEC ($mol.ckg^{-1}$) 141.7. Also peat is relatively " a sterile medium" i.e. as it was produced under anaerobic decomposition of water loving plants. In this concern, Wilson (1986) and Urrestarazu *et al*., (2001) found that different treatments and controls (peat moss and perlite) were significant for root and stem dry weights and they revealed that peat moss control treatment was more efficient than the investigated composts. Also, data presented in Table (3) show that the compost mix. No. 3 significantly increased both fresh and dry weights of tomato seedlings when compared with compost mixs No. 1 and No. 2, probably because of the microbial inoculation in addition of the rock phosphate and feldspar of compost mix No. 3. In this concern, Inbar *et al*., (1986) suggested that high activity of the microbial population may increase growth response. Also, Martin and Gershung (1992) revealed that there are two ways in which these substances may influence a compost heap i.e. 1- by introducing strains of microorganisms that are effective in breaking down organic materials and 2- by increasing the nitrogen and nutrients content of organic materials, which increase both fresh and dry weights of tomato seedlings.

Table 3: Effect of compost Type (A), mixing components (B), nutrients enrichment (C) and washing (D) on fresh and dry weights of tomato seedlings grown on different prepared compost types as growing media.

Fresh weight g/seedling							
Compost types (A)		Mixing components (B)		nutrients enrichment (C)		Washing (D)	
Peat moss (control)	2.30	100 % Compost or p	1.96	Non-enriched	2.610	Unwashed	2.12
Comp. mix 1	2.07						
Comp. mix 2	2.05	50%Vermiculite+ 50% comp. or p	2.71				
Comp. mix 3	2.25						
Comp. mix 4	2.37	50 % Sand+ 50% comp.or p	2.01	Enriched	1.84	Washed	2.73
LSD 5%							
A = 0.03		B = 0.04		C = 0.066		D = 0.26	
Dry weight mg/seedling							
(A)		(B)		(C)		(D)	
Peat moss (control)	204.27	100 % Compost or P	164.88	Non-enriched	234.34	Unwashed	165.70
Comp. mix 1	177.62						
Comp. mix 2	174.99	50%Verm+50% comp. or p	230.09				
Comp. mix 3	197.91						
Comp. mix 4	223.45	50 % Sand+50% comp. or p	196.24	Enriched	159.80	Washed	173.36
LSD 5%							
A = 3.621		B = 3.912		C = 4.781		D = 5.11	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P= peat moss

Comp. mix. 1 = (RS + BW + PM).

Comp. mix. 2 = (RS + BW + PM) + microbial inoculation

Comp. mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar

Comp. mix. 4 = (RS + BW + PM) + Tea compost

Generally, it is profitable to observe that the control media (peat moss) and the tested growing media according to their inducing effect on both fresh and dry weights of tomato seedlings could be arranged in descending order of: compost mix. No. 4 > peat moss > compost mix. No. 3 > compost mix. No.1> compost mix. No.2

Effect of Mixing Components (B):

Regardless, the effect of compost type (A), nutrients enrichment (C) and washing effect (D), data presented in Table (3) show that the most effective mixing component was that containing 50 % vermiculite + 50 % compost or peat, which showed average fresh and dry weights of 2.71 g / seedling and 230.09 mg/ seedling, respectively. These results may be because vermiculite could be more satisfactory for rooting medium and a good yield of tomato. Also vermiculite has a high base exchange capacity and appreciable quantities of magnesium (Wilson, 1986). The obtained results are in accordance with the finding of El-Beltagy *et al*. (1986), Abou-Hadid *et al.* (1994) and Hellal *et al.* (1996) who found that peat moss with vermiculite (1:1) gave the best growth of tomato and cucumber seedlings.

Data in Table (3) show that the mixing component of 50% sand + 50 compost or peat significantly increased the fresh and dry weights of tomato seedlings as compared with those obtained by using 100 % compost or peat, which agrees with Omar and Helmy (2001) who found satisfactory effect by (Sand + Compost 1:1 v/v) compared to the other tested root media.

Generally, the highest values of fresh and dry weights of tomato seedlings were attained by using 50% vermiculite + 50% compost or peat followed by 50% sand + 50% compost or peat and 100 % compost or peat moss in decreasing order. Came to the same results Hellal *et al.* (1996) and Moursy (2001) who stated that the highest net assimilation rate was observed with the peat moss + vermiculite followed by peat moss + sand treatments. They added that mixing of different organic media with vermiculite and sand significantly increased the dry weight of banana seedlings than using organic media alone in most growth period of plant.

Effect of Nutrients Enrichment (C):

Results in Table (3) indicate that on average and individual values scale, the fresh and dry weights of tomato seedlings under non-enrichment treatments (2.61 g/seedling and 234.34 mg/seedling, respectively) surpassed all the corresponding values under enrichment treatments (1.84 g/ seedling and 159.80 mg/ seedling, respectively). This may be probably due to the higher values of EC and pH of enriched media than the non-enriched ones.

Washing Effect (D):

Data presented in Table (3) show that all the compost piles which were subjected to washing gave significantly higher increases in fresh and dry weights of tomato seedlings (2.73g/seedling and 173.30 mg/seedling, respectively) than the treatments which were not washed (2.12 g/seedling and 165.70 mg/seedling, respectively). In this concern, several research workers have actually wash the alkalinity out the vermiculite before using it (Went, 1957 and Wilson, 1983). Furthermore, Inbar *et al.* (1986) and Urrestarazu *et al.* (2001) stated that it can be deduced that in order to utilize the evaluated compost for seedling production, it would be necessary to correct pH and reduce salinity by leaching. They added that the compost separated manure (CSM) contains initially very high NPK levels and hence high salinity and therefore requires leaching perior to its use. The substrates were leached by 3 volumes of water perior to planting.

Interaction Effects:

The interactions between the main factors under study are presented in Table (4).

A X B Iteraction:

The interactions between the compost type (A) and the mixing components (B) significantly affected the fresh and dry weights of tomato seedlings. The highest values of both fresh and dry weights of tomato seedlings average 2.96 g/seedling and 267.88 mg/seedling, respectively occurred under vermiculite component mixture (50% vermiculite + 50 % compost mix No. 1). The lowest values were 1.19 g/seedling and 101.75 mg/seedling for fresh and dry weights occurred under compost mix. No. 1 without any mixing neither with vermiculite nor with sand (100% compost mix. No. 1) as shown in Table (4).

A X C Interaction:

The interaction between compost type (A) and nutrients enrichment (C) significantly affected both fresh and dry weights of tomato seedlings. The highest values (3.19 g/ seedling and 308.43 mg/ seedling, respectively) were occurred under non-enriched treatments and compost mix. No.4, while the lowest values of fresh and dry weights (1.36 g/ seedling and 116.25 mg/ seedling, respectively) were found under the enriched treatments and compost mix. No. 1 (Table 4).

B X C Interaction:

Data in Table (4) show the highest values of fresh and dry weights of tomato seedlings (3.3 g/seedling and 269.2 mg/seedling) were occurred under non-enriched treatment and 50 % vermiculite + 50 % compost or peat. Moreover, the lowest values (1.69 g/seedling and 134.29 mg/seedling) were attained under enriched treatment and 100 % compost or peat.

A X B X C X D Interactions:

Both the highest values of fresh and dry weights of tomato seedlings (4.96 g/seedling and 476.10 mg/seedling, respectively) were attained when non-enriched, washed treatments and the mixing components of 50 % vermiculite + 50 % compost or peat were used (Table 4).

Nutrients Status of Tomato Seedlings:

It is well established that the use of organic media as substrates for plant growth depends on physical, chemical properties and nutrients availability in such media.

Macronutrients (N, P and K) Uptake:

Effect of the Main Factors:

Data in Table (5, 6 and 7) show the behaviour of the main factors effects, compost type (A), mixing components (B), nutrients enrichment (C) and pile washing (D) on N, P and K uptake by tomato seedlings.

Table 4: Interaction effect between each different pairs of the factors: compost types (A), mixing components (B), nutrients enrichment (C) and washing (D) on both fresh and dry weights of tomato seedlings grown on different prepared compost as growing media.

A X B

	Fresh weight of tomato seedling g/seedling			Dry weight of tomato seedling mg/seedling		
	Mixing components (B)			Mixing components (B)		
(A) Compost types	100 % compost or p	50 % vermiculite +50% comp. or p	50 % sand+ 50% comp.or p	100 % compost or p	50 % vermiculite +50% comp. or p	50 % sand+ 50% comp.or p
Control(Peat moss)	2.05	2.63	2.23	167.00	234.00	211.00
Comp. mix 1	1.19	2.96	2.01	101.75	367.88	163.37
Comp. mix 2	2.04	2.72	1.66	174.75	214.44	155.06
Comp. mix 3	2.01	2.86	1.98	189.02	201.13	231.68
Comp. mix 4	2.40	2.72	1.98	218.61	227.88	223.88

A X C

	Fresh weight of tomato seedling g/seedling		Dry weight of tomato seedling mg/seedling	
	nutrients enrichment (C)			
(A) Compost types	Non-enriched	Enriched	Non-enriched	Enriched
Control(Peat moss)	2.10	2.16	227.10	181.41
Comp. mix 1	2.75	1.36	239.18	116.25
Comp. mix 2	2.60	1.52	232.58	117.42
Comp. mix 3	2.90	1.66	263.13	132.69
Comp. mix 4	3.19	1.54	308.43	138.47

B X C

(B) Mixing components	Fresh weight of tomato seedling g/seedling		Dry weight of tomato seedling mg/seedling	
	nutrients enrichment (C)			
	Non-enriched	Enriched	Non-enriched	Enriched
100 % compost or P	2.22	1.69	195.46	134.29
50 %vermiculite + 50% comp. or P	3.30	2.12	269.20	190.98
50 % sand + 50% comp. or P	2.30	1.72	238.36	154.17

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, p= peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Compost Mix. 4 = (RS + BW + PM) + Tea compost
A X B X C X D
Fresh weight g/seedlings
4.969 g/seedling-compost mix.4 – 50% vermic.+ 50% compost – non-enriched –washed.
Dry weight mg/seedling
476.1 mg/seedling-compost mix.4 – 50% vermic.+ 50% compost – non-enriched –washed.

Effect of Compost Type (A):

Data in Table (5, 6 and 7) show that the compost types (A) significantly affected N, P and K uptake by tomato seedlings. The hiughest N, P and K values were occurred with comp. mix. No. 4 (6.79, 1.24 and 5.09) followed by comp. mix.No. 3 (6.27, 1.19 and 4.94 mg/seedling for N, P and K, respectively). The N, P and K values of comp. mix. No. 1, 2 and peat moss were lower than those of comp. mix. No. 4 and 3. The significant differences among different media may suggest that media could play an important role on the assimilation of nutrients on the growth (Wang *et al*., 1984).

The superiority of comp. mix. No. 3 over those of No. 1 and 2 with respect to NPK content of tomato seedling may be due to the bacterial inoculation as well as the addition of rock phosphate and feldspar. These results are in consonance with the findings of Biswas and Narayanasamy (2002) and Tengerdy and Szakacs (2003) who reported that mixing rock phosphate with the compost prepared from rice straw significantly increased its content of available N, P and K compared to control. They added also that enrichment the compost with Aspergillus and Trichoderma strains greatly increased the availability of different nutrients as compared with non-inoculated treatment.

Generally, data in Table (5, 6 and 7) reveal that the highest values of N, P and K uptake by tomato seedlings occurred with comp. mix. No. 4 followed by comp. mix. No. 3 but the lowest values of P and K uptake were found by using comp. mix. No. 2, while the lowest N values occurred with comp. mix. No.1.

Table 5: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on N uptake by tomato seedlings grown on different prepared compost types as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total N uptake mg/seedling						
Peat moss (control)	2.43	3.07	6.97	7.49	5.93	8.12	5.66
Comp. mix 1 Unw	4.31	2.34	9.35	4.79	6.43	2.58	4.97
Comp. mix 2 Unw	6.87	2.59	6.58	3.25	6.86	2.69	4.81
Comp. mix 3 Unw	6.23	4.18	7.91	3.91	5.29	2.38	4.98
Comp. mix 4 Unw	12.91	3.38	7.12	5.13	9.12	2.71	6.73
Comp. mix. 1 W	3.68	2.05	12.81	3.79	6.39	6.49	5.84
Comp. mix. 2 W	7.07	5.51	11.39	5.03	6.66	2.99	6.44
Comp. mix. 3 W	5.52	4.94	15.67	5.56	9.00	4.78	7.56
Comp. mix. 4 W	6.59	5.50	13.10	6.35	5.89	3.68	6.85

Main effects

(A) compost types mg/seedling		(B) mixing components mg/seedling		(C) Enrichment mg/seedling		(D) washing effect mg/seedling	
Peat moss (control)	5.66	100% compost or p	5.25	Non-enriched	8.03	Unwashed	5.37
Comp. mix 1	5.41						
Comp. mix 2	5.63	50 % vermiculite+ 50% comp. or p		7.61			
Comp. mix 3	6.27						
Comp. mix 4	6.79	50 % sand+ 50% comp. or p	5.23	Enriched	4.03	Washed	6.68
LSD 5%	A=0.093	B=0.116		C=0.200		D=0.301	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P= peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Table 6: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on P uptake by tomato seedlings grown on different prepared compost types as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total P uptake mg/seedling						
Peat moss (control)	0.68	1.19	0.98	2.01	1.00	1.36	1.22
Comp. mix1 Unw	0.96	0.42	2.08	1.11	1.13	0.41	1.01

Table 6: Continued.

Comp. mix2 Unw	1.33	0.56	1.44	0.67	0.96	0.49	0.91
Comp. mix3 Unw	1.05	0.84	1.52	0.83	0.99	0.45	0.94
Comp. mix 4 Unw	2.42	0.56	1.76	1.02	1.21	0.46	1.24
Comp. mix 1 W	0.74	0.45	2.69	0.80	0.68	1.16	1.09
Comp. mix 2 W	1.44	1.04	1.85	1.13	0.95	0.54	1.16
Comp. mix 3 W	1.30	0.88	2.94	1.29	1.35	0.84	1.43
Comp. mix 4 W	1.33	1.02	1.97	1.41	0.92	0.74	1.22

Main effects

(A) compost types mg/seedling		(B) mixing components mg/seedling		(C) Enrichment mg/seedling		(D) washing effect mg/seedling	
Peat moss (control)	1.22	100% compost or p	1.03	Non-enriched	1.46	Unwashed	1.03
Comp. mix 1	1.07						
Comp. mix 2	1.04	50% verm.+50% comp. or p	1.54				
Comp. mix 3	1.19						
Comp. mix 4	1.24	50 % sand +50% comp. or p	0.83	Enriched	0.80	Washed	1.23
LSD 5%	A=0.019		B=0.023		C=0.040		D=0.062

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Compost Mix. 4 = (RS + BW + PM) + Tea compost

Table 7: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on K uptake by tomato seedlings grown on different prepared compost types as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total K uptake mg/seedling						
Peatmoss(control)	3.33	4.13	4.10	6.58	4.09	4.84	4.51
Comp. mix 1 Unw	3.70	1.51	7.11	4.22	5.24	1.62	3.90
Comp. mix 2 Unw	3.63	2.06	5.75	2.72	4.58	2.12	3.80
Comp. mix 3 Unw	4.25	3.22	7.48	3.31	4.43	1.87	4.09
Compost 4 Unw	9.07	2.21	6.34	4.07	5.99	1.91	4.94
Comp. mix 1 W	3.27	1.63	11.16	3.15	4.29	4.64	4.52
Comp. mix 2 W	5.54	4.11	5.69	2.03	6.68	3.42	4.58
Comp. mix 3 W	5.79	3.40	10.93	4.79	6.64	3.20	5.79
Comp. mix 4 W	6.61	4.01	8.68	5.08	4.35	2.65	5.24

Main effects

(A) compost types mg/seedling		(B) mixing components mg/seedling		(C) Enrichment mg/seedling		(D) washing effect mg/seedling	
Peat moss (control)	4.51	100% compost or p	4.13	Non-enriched	6.22	Unwashed	4.18
Comp. mix 1	4.21						
Comp. mix 2	4.19	50 % vermiculite +50% comp. or p		5.79			
Comp. mix 3	4.94						
Comp. mix 4	5.09	50 % sand +50% comp. or p	3.98	Enriched	3.04	Washed	5.07
LSD 5%	A=0.083	B = 0.102		C = 0.176		D = 0.321	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, p = peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Effect of Mixing Components (B):

Data in Tables (5, 6 and 7) show that the values of N, P and K uptake by tomato seedlings were significantly higher when the mixing components of 50%vermiculite + 50% compost or peat moss was used (7.61, 1.54 and 5.79 mg/seedling for N, P and K, respectively), followed by 100 % compost without mixing with neither vermiculite nor sand (5.25, 1.03 and 4.13 mg/seedling for N, P and K, respectively), and 50 % sand + 50 % compost or peat moss (5.23, 0.83 and 3.98 mg NPK/seedling, respectively). These results may be due to the effect of added components (vermiculite) on pH and CEC of the mixture as suggested by Jesperesen and Willumsen (1993) who showed that, the composted agricultural wastes might improve pH values when peat and composted agricultural wastes together were used as soil substrates. They found that pH values for peat, mixture of peat and compost (70:30 v/v) and mixture of peat and compost (80:20 v/v) were 4.7, 5.6 and 5.1, respectively, while the recorded pH value for compost was 6.6. They added also that CEC of compost, peat, mixture of peat + compost (70:30 v/v) were 106.6, 165.4 and 178.8 meq/100 g, which means that the CEC of the mixture was better than that of peat moss and compost due to the volume percentage of the mixture. These obtained results are confirmed by Hellal *et al.* (1996) and Moursy (2001) who reported that seedlings grown in peat moss + vermiculite gave high N, P and K concentrations as well as chlorophyll content.

***Effect of Nutrients Enrichment (C)*:**

Data in Tables (5, 6 and 7) reveal that while the nutrients enrichment of compost soundly decreased NPK uptake by tomato seedlings, the revers was true with all peat moss control treatments, probably because of the high nutrient content of prepared compost than the peat moss.

***Effect of Washing (D)*:**

Data in Tables (5, 6 and 7) show a positive significant effect on NPK uptake by tomato seedlings due to washing of all the tested media as compared with the unwashed ones. Such trend could be attributed to the reduction of all media salinity and lowering the high analysis of prepared compost, just suggested before under the effect of nutrient enrichment effect. Noteworthy referring that almost similar trends were obtained with Urrestarazu *et al.* (2001).

Interaction Effects:

The obtained results in Table (8) show significant positive interactions between all the tested main factors combination on the N, P and K uptake by tomato seedlings as follows:

Table 8: Interactions effect between each different pairs of the factors: compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on the uptake of N, P and K (mg/seedling) by tomato seedlings grown on different prepared composts as growing media.

A X B

	Mixing components (B)								
	100 % compost or p			50 % vermiculite+50% comp. or p			50 % sand+50% comp. or p		
	N, P and K uptake by tomato seedlings mg/seedling								
Compost types (A)	N	P	K	N	P	K	N	P	K
Peat noss (control)	2.75	0.94	3.73	7.23	1.49	5.34	7.03	1.18	4.46
Comp. mix 1	3.16	0.65	2.53	7.69	1.65	6.42	5.47	0.85	3.95
Comp. mix 2	5.51	1.10	4.34	6.56	1.28	4.05	4.80	0.74	4.20
Comp. mix 3	5.22	1.02	4.17	8.26	1.68	6.63	5.36	0.91	4.04
Comp. mix 4	7.10	1.34	4.48	7.92	1.54	6.05	3.35	1.08	3.73
LSD 5%	0.211	0.042	0.191	0.211	0.042	0.191	0.211	0.042	0.191

A X C

	Nutrients enrichment (C)					
	Uptake mg/seedling					
	Non-enriched			Enriched		
Compost types (A)	N	P	K	N	P	K
Peat noss (control)	5.32	0.89	4.09	6.10	1.52	4.93
Comp. mix 1	7.16	1.38	5.80	3.67	0.73	2.80
Comp. mix 2	7.57	1.33	5.65	3.67	0.74	2.74
Comp. mix 3	8.27	1.53	6.59	4.29	0.86	3.36
Comp. mix 4	9.12	1.60	6.84	4.45	0.87	3.32
LSD 5%	0.212	0.059	0.262	0.212	0.059	0.262

B X C

	Nutrients enrichment (C)					
	Uptake mg/seedling					
	Non-enriched			Enriched		
Mixing components (B)	N	P	K	N	P	K
100% comp. or p	5.46	1.11	4.76	3.35	0.88	3.22
50 % vermiculite+50 % comp. or p	9.32	1.68	6.63	5.65	1.36	4.64
50 % sand+50% comp. or p	6.62	1.02	5.13	5.07	0.88	3.15
LSD 5%	0.321	0.063	0.281	0.321	0.063	0.281

A X B Interaction:

The interaction between compost types (A) and the mixing components (B) showed significant effect on N, P and K uptake by tomato seedlings. The highest values of N, P and K were occurred under 50 % vermiculite + 50% compost or peat moss (8.26, 1.68 and 6.63 mg/seedling, respectively) and using the compost type No.3, while the lowest values for the previous nutrients were recorded under 100 % compost or peat moss (3.16, 0.65 and 2.53 mg/seedling, respectively) without mixing with neither vermiculite nor sand and using the compost type No.1.

A X C Interaction:

The interaction between compost types (A) and nutrients enrichment (C) positively and significantly affected the uptake of N, P and K by tomato seedlings. The highest values of N, P and K were occurred under non-enriched treatments and compost mix. No. 4 (9.12, 1.60 and 6.84 mg/seedling, respectively), while the lowest ones (3.67, 0.73 and 2.80 mg/seedling) were found under enriched treatments and compost mix. No.1.

B X C Interaction:

The highest values for each of N, P and K uptake by tomato seedlings (9.32, 1.68 and 6.63 mg/seedling, respectively) were occurred under 50% vermiculite + 50% compost or peat moss in absence of nutrients enrichment. Moreover, the lowest value of N uptake was found under 100 % compost or peat moss, while those of P and K uptake under 100% compost and 50% sand + 50% compost did not significantly differ.

A X B X C X D Interactions:

The interactions between all the main factors (A, B, C and D) significantly affected N, P and K uptake by tomato seedlings. Generally, the highest values of N, P and K (476.1, 2.94 and 11.16 mg/seedling respectively) were occurred under 50 % vermiculite + 50 % compost or peat moss and compost type No. 4 which was non-enriched but washed.

Micronutrients Uptake (Fe, Mn, Zn and Cu):
Effect of the Main Factor (A, B, C and D):
Effect of Compost Type (A):

Regardless the effect of mixing components (B), nutrients enrichment (C) and washing effect (D), data in Tables 9, 10, 11 and 12 show that the compost type No.4 significantly increased the uptake of Fe, Mn, Zn and Cu by tomato seedlings as compared with the other compost types i.e. compost types No. 1, 2 and peat moss (control). Data also show that the lowest values of Fe and Zn were occurred under compost type No. 2 while for Mn and Cu were attained under the peat moss (control). Moreover, data reveal that the compost types No. 3 significantly increased the uptake of all micronutrients under study (Fe, Mn, Zn and Cu) as compared with compost types No.1, 2 and the control treatment (peat moss). This may be due to the addition of rock phosphate and feldspar as well as microbial inoculation to the compost type No. 3. In this concern, Urrestarazu *et al.* (2001) and El-Haggar *et al.* (2004) stated that microbial enrichment occurred correct and rapid maturity of compost and therefore removal of phytotoxic substances were occurred. They added that addition of natural minerals (rock phosphate and feldspar) enriches the degradation rate of organic matter, reduces nitrogen volatization, increases the percentage of humic substances in the end product and releases some macro and micronutrients and transfers them to the soluble form available to plants.

Effect of Mixing Components (B):

Irrespective of the effect of compost type (A), nutrients enrichment (C) and washing effect (D), data presented in Tables (9-12) reveal that the mixing components (B) factor significantly affected the uptake of Fe, Mn, Zn and Cu by tomato seedlings. The mixing component of 50 % vermiculite + 50 % compost or peat moss gave the highest significant effect on the uptake of the micronutrients under study as compared with the other two mixing components i.e. 100 % compost or peat moss without any mixng and 50 % sand + 50 % compost or peat moss. The highest uptake values of Fe, Mn, Zn and Cu were occurred by using 50 % vermiculite + 50 % compost or peat moss followed by 100 % compost or peat moss and 50 % sand + 50 % compost or peat moss in descending order. The surpassed dramatically effect of 50 % vermiculite + 50 % compost may be due to the importance of the water movement from the surrounding soil and the availability of water and nutrients to seedling roots as reported by Moursy (2001). Also, Ingelma *et al.* (1998) stated that all peat-alternative substrates showed higher micro-porosities and this fact is particularly interesting, since increases in micro porosity improve rewettability of substrates due to both an increase in their water-holding capacity and also a reduction of drainage (Beardsell and Nichols, 1982).

Nutrients Enrichment (C):

Data presented in Tables (9-12) showed that the non-enriched treatments gave significantly higher values of Fe, Mn, Zn and Cu uptake by tomato seedlings as compared with those enriched treatments. These results are true under all the compost types No.1, 2, 3 and 4. These obtained results were in against with those obtained by peat moss (control), where the enriched treatments gave significantly higher values as compared with those non- enriched treatments.

Washing Effect (D):

Data in Tables (9-12) show that the washed treatments significantly increased Fe, Mn, Zn and Cu uptake by tomato seedlings as compared with those unwashed treatments. This effect may be due to the leaching of the excess salts and the decreasing effect of washing on pH values.

Table 9: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on Fe uptake by tomato seedlings grown on different prepared compost types as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total Fe uptake µg/seedling						
Peat moss(control)	37.25	55.11	61.33	75.20	42.23	60.60	63.64
Comp. mix. 1 Unw	66.80	33.80	153.05	90.68	56.28	32.93	72.26
Comp. mix. 2 Unw	94.50	43.53	104.03	58.23	53.15	42.00	65.90
Comp. mix. 3 Unw	76.88	66.18	137.47	73.63	48.05	36.50	73.64
Comp. mix. 4 Unw	156.55	45.68	130.55	88.05	68.38	37.88	87.64
Comp. mix. 1 W	43.30	31.18	177.55	61.90	37.05	90.03	73.50
Comp. mix. 2 W	84.70	80.55	132.60	80.30	41.05	40.18	76.56
Comp. mix. 3 W	74.85	70.60	174.67	97.40	61.63	62.93	90.34
Comp. mix. 4 W	81.08	78.98	127.40	102.95	38.70	53.80	80.48

Main effects

(A) compost types µg/seedling		(B) mixing components µg/seedling		(C) Nutrients Enrichment µg/seedling		(D) washing effect µg/seedling	
Peat moss (control)	74.56	100% compost or p	70.58	Non-enriched	92.51	Unwashed	74.79
Comp. mix. 1	72.88						
Comp. mix. 2	71.34	50% verm. + 50 % comp. or p	111.91				
Comp. mix. 3	81.99			Enriched	62.50	Washed	80.22
Comp. mix.4	84.06	50 % sand + 50 % comp. or p	50.04				
LSD 5%	A= 2.135	B= 2.615		C= 4.529		D= 5.110	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P= peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Table 10: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on Mn uptake by tomato seedlings grown on different prepared composts types as growing media.

	Mixing components (B)						
	100% compost or p		50 % verm.+50% comp. or p		50% sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total Mn uptake µg/seedling						
Peat moss (control)	8.93	26.38	16.11	42.95	11.03	23.65	21.51
Comp. mix 1 Unw	19.15	10.93	49.70	31.58	20.03	10.25	23.60
Comp. mix 2 Unw	27.98	13.75	33.70	20.00	17.55	12.48	20.91
Comp. mix 3 Unw	25.67	22.18	42.77	23.35	20.50	11.68	24.35
Comp. mix 4 Unw	53.13	15.58	39.13	31.35	23.90	12.38	29.25

Table 10: Continue

Comp. mix 1 W	14.43	10.17	53.38	19.88	12.40	26.20	22.74
Comp. mix 2 W	26.03	26.98	41.73	27.25	13.45	11.04	24.41
Comp. mix 3 W	23.78	23.00	56.38	31.78	10.75	19.05	27.45
Comp. mix. 4 W	31.35	25.55	42.45	32.60	13.10	14.73	26.63

Main effects

(A) compost types µg/seedling		(B) mixing components µg/seedling		(C) Enrichment µg/seedling		(D) washing effect µg/seedling	
Peat moss (control)	21.51	100% compost or p	23.11	Non-enriched	30.94	Unwashed	24.53
Comp. mix 1	23.17						
Comp. mix 2	22.66	50 % vermiculite+ 50 % comp. or p	36.07				
Comp. mix 3	25.90			Enriched	20.16	Washed	25.31
Comp. mix 4	27.94	50 % sand + 50 % comp. or p	17.47				
LSD 5%	A=0.379	B=0.464		C=0.804		D=0.680	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P = peat moss
Comp. mix . 1 = (RS + BW + PM).
Comp. mix . 2 = (RS + BW + PM) + microbial inoculation
Comp. mix 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. mix . 4 = (RS + BW + PM) + Tea compost

Table 11: Effect of compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on Zn uptake by tomato seedlings grown on different types of prepared compost as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total Zn uptake µg/seedling						
Peat moss(control)	23.30	44.35	36.00	75.55	24.23	42.68	41.10
Comp. mix 1 Unw	33.70	17.63	83.20	49.13	35.08	16.35	39.31
Comp. mix 2 Unw	49.50	23.53	57.58	32.60	31.20	22.08	36.08
Comp. mix 3 Unw	41.13	25.70	70.38	42.18	32.28	19.10	40.32
Comp. mix 4 Unw	83.65	25.70	70.60	50.15	46.43	19.75	49.39
Comp. mix 1 W	25.73	17.48	91.65	35.63	24.93	47.80	40.53
Comp. mix 2 W	43.63	45.75	75.78	45.40	24.77	20.90	42.71
Comp. mix 3 W	44.73	38.35	105.40	51.80	39.53	35.78	52.60
Comp.mix 4 W	49.57	43.48	80.35	56.18	24.83	27.95	47.06

Main effects

(A) compost types µg/seedling		(B) mixing components µg/seedling		(C) Nutrients Enrichment µg/seedling		(D) washing effect µg/seedling	
Peat moss(control)	41.10	100% compost or p	38.78	Non-enriched	52.47	Unwashed	41.24
Comp. mix. 1	39.92						
Comp. mix. 2	39.40	50% verm.+ 50 % comp. or p	62.38				
Comp. mix. 3	46.46			Enriched	34.23	Washed	45.75
Comp. mix. 4	48.23	50 % sand + 50 % comp. or p	29.31				
LSD 5%	A= 0.559	B= 0.685		C= 1.185		D= 2.680	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P= peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Table 12: Effect of compost type (A), mixing components (B), Nutrients enrichment (C) and washing (D) on Cu uptake by tomato seedlings grown on different prepared composts as growing media.

	Mixing components (B)						
	100 % compost or p		50 % vermiculite+50% comp. or p		50 % sand+50% comp. or p		
	Nutrients enrichment (C)						
Compost types (A)	Non-enriched	Enriched	Non-enriched	Enriched	Non-enriched	Enriched	Mean
	Total Cu uptake µg/seedling						
Peat moss(control)	2.73	6.17	5.46	9.33	2.44	7.27	5.67
Comp. mix 1 Unw	9.46	4.10	17.14	12.08	8.56	3.63	9.16

Table 12: Continued

Comp. mix 2 Unw	12.08	4.81	13.59	7.93	7.93	5.23	8.59
Comp. mix 3 Unw	8.54	8.18	15.74	9.96	7.79	4.05	9.05
Comp. mix 4 Unw	20.92	5.80	15.41	11.92	9.49	4.79	11.39
Comp. mix 1 W	4.25	3.63	18.39	8.11	5.17	9.96	8.25
Comp. mix 2 W	8.21	10.40	16.13	10.59	4.79	4.04	9.03
Comp. mix 3 W	8.07	8.55	19.98	11.83	5.87	7.26	10.26
Comp. mix 4 W	8.07	9.18	13.30	13.16	4.46	5.34	8.91

Main effects

(A) compost types µg/seedling		(B) mixing components µg/seedling		(C) Enrichment µg/seedling		(D) washing effect µg/seedling	
Peat moss (control)	7.73	100% compost or P	8.39	Non-enriched	10.97	Unwashed	9.11
Comp. mix 1	8.71						
Comp. mix 2	8.81	50% verm.+ 50 % comp. or P	13.46				
Comp. mix 3	9.66			Enriched	7.69	Washed	9.61
Comp. mix 4	10.15	50 % sand + 50 % comp. or p	6.15				
LSD 5%	A=0.281	B = 0.344		C = 0.597		D = 0.321	

RS= Rice straw, BW= Banana wastes, PM= Poultry manure, Unw= unwashed, W= washed, P= peat moss
Comp. Mix. 1 = (RS + BW + PM).
Comp. Mix. 2 = (RS + BW + PM) + microbial inoculation
Comp. Mix. 3 = (RS + BW + PM) + microbial inoculation + Rock phosphate + Feldspar
Comp. Mix. 4 = (RS + BW + PM) + Tea compost

Effect of the Interaction Between the Main Factors:

All the interactions between the main factors (A, B, C and D) significantly affected the uptake of Fe, Mn, Zn and Cu by tomato seedlings grown on different prepared media (Table 13).

A X B Interaction:

Results presented in Table (13) indicate that the interaction between compost types (A) and mixing components (B) significantly affected the uptake of Fe, Mn, Zn and Cu by tomato seedlings. The highest values of Fe, Zn and Cu uptake (120.72, 67.49 and 14.38 ug/seedling, respectively) by tomato seedlings occurred under 50 % vermiculite + 50 % compost or peat moss and using compost mixture No. 3, while the highest value of Mn (41.39 ug/seedling) was found under 50 % vermiculite + 50 % compost or peat moss and using compost mixture No. 4. Moreover, data show that the lowest values of the uptake of Fe, Mn and Cu by tomato seedlings (43.64, 13.67 and 5.36 ug/seedling, respectively) were occurred under 100 % compost or peat moss without any mixing with vermiculite or sand and by using compost mixture No. 1, while the lowest value of Zn (24.74 ug/seedling) was found under 50 % sand + 50 % compost and using compost mix. No. 2.

A X C Interaction:

The interaction of compost type (A) and nutrients enrichment (C) is illustrated in the highest values of Fe, Mn, Zn and Cu uptake by tomato seedlings (100.44, 33.84, 59.23 and 11.00 ug/seedling, respectively) which occurred under non-enriched treatments and compost mixture No. 4 for Fe, Mn and Zn and compost mix. No. 3 for Cu. Furthermore, data in Table (13) show that the lowest values of Fe, Mn, Zn and Cu uptake (46.94, 12.02, 27.84 and 3.54 ug/seedling, respectively) were attained under non-enriched treatments and peat moss treatment (control).

Table 13: Interactions effect between each different pairs of the factors: compost type (A), mixing components (B), nutrients enrichment (C) and washing (D) on the uptake of Fe, Mn, Zn and Cu (ug/seedling) by tomato seedlings grown on different prepared composts as growing media.

A X B												
	Mixing components (B)											
	Uptake µg/seedling											
	100 % compost or p				50 % vermiculite+50% comp. or P				50 % sand+50% comp. or P			
Compost types (A)	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Peat moss (control)	61.95	17.66	33.82	5.95	96.74	29.53	55.78	10.90	65.02	17.34	33.46	6.35
Comp. mix. 1	43.64	13.67	30.18	5.36	120.50	38.64	64.91	13.93	54.07	17.22	31.04	6.84

Table 13: Continued

Comp. mix. 2	73.83	23.69	40.62	8.88	93.79	30.67	52.84	12.06	44.10	13.69	24.74	5.50
Comp. mix. 3	72.13	23.62	40.24	8.34	120.72	38.57	67.44	14.38	52.28	15.54	31.68	6.22
Comp. mix. 4	90.57	31.41	50.61	10.99	112.24	41.39	64.32	13.45	49.69	16.03	29.74	6.02
LSD 5%	4.75	0.89	1.25	0.65	4.75	0.89	1.25	0.65	4.75	0.89	1.25	0.65

A X C

	Nutrients enrichment (C)							
	Uptake µg/seedling							
	Non-enriched				Enriched			
Compost types (A)	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Peat moss (control)	46.94	12.02	27.84	3.54	63.64	30.99	54.19	7.59
Comp. mix. 1	89.00	28.18	49.05	10.50	56.75	18.17	30.67	4.91
Comp. mix. 2	85.00	26.74	47.09	10.46	57.47	18.58	31.71	7.16
Comp. mix. 3	95.32	29.98	55.58	11.00	67.86	21.84	37.33	6.65
Comp. mix. 4	100.44	33.84	59.23	10.36	67.89	22.03	37.19	8.38
LSD 5%	6.750	1.185	1.754	0.879	6.750	1.185	1.754	0.879

B X C

	Nutrients enrichment (C)							
	Non-enriched				Enriched			
Mixing components (B)	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
100% comp. or p	68.97	21.44	38.74	7.54	66.43	21.14	35.51	7.61
50 % vermiculite+ 50% comp. or p	115.22	35.34	64.91	12.63	98.48	33.47	55.44	12.57
50 % sand + 50% comp. or p	47.77	14.65	29.67	5.32	62.29	17.70	31.70	7.12
LSD 5%	7.150	1.272	1.880	0.945	7.150	1.272	1.880	0.945

B X C Interaction:

Data presented in Table (13) reveal that the interaction between mixing components (B) and nutrients enrichment (C) significantly affected the uptake of all micronutrients under study. The highest significantly values of Fe, Mn, Zn and Cu (115.22, 35.34, 64.91 and 12.63 ug/seedling, respectively) were obtained under non-enriched treatments and 50 % vermiculite + 50 % compost or peat moss, while the lowest values of the previous micronutrients were occurred where 50 % sand + 50 % compost or peat moss was used under the non-enriched treatments (47.77, 14.65, 29.67 and 5.32 ug/seedling, for Fe, Mn, Zn and Cu, respectively). It could be arrange the three methods of mixing components (B) as follows: 50 % vermiculite + 50 % compost or peat moss followed by 100 % compost or peat moss without any mixing and 50 % sand + 50 % compost or peat moss in decreasing order.

A X B X C X D Interaction:

After calculation the interactions between all the main factors results show that the highest values of Fe and Mn uptake by tomato seedlings (177.55 and 53.38 ug/seedling, respectively) were found under non-enriched treatments (C), washed (D), 50 vermiculite + 50 % compost (B) and compost mixture No. 1, while the highest values of Zn and Cu (105.40 and 20.92 ug/seedling, respectively) were occurred under non-enriched treatments (C), washed (D), 50% vermiculite + 50% compost or peat moss (B) and compost mixtures No. 3 and No. 4, respectively.

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