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Production of Organic Tomato Transplants by Using Compost as Alternative Substrate for Peat-Moss

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Abstract: In order to find appropriate methods to produce good quality organic tomato transplants, tomato hybrid cv. Super Strain B transplants were grown in peat-moss and vermiculate (by 1:1 volume) as essential medium with 5 ratios of compost as a ratio from peat-moss volume, viz., zero, 25, 50, 75 and 100% and fertilized with 4 ratios of rabbit manure, viz., zero, 0.3, 0.6 and 0.9 g/cell. The germination and the effects on transplants morphological and nutritional aspects of the different mixtures used were studied. Increasing compost and rabbit manure rates decreased the germination percentage. Stem diameter, number of leaves and fresh and dry weights increased with increasing rates of compost and rabbit manure reaching a maximum at 50% and 0.6 g rate, respectively and then declined at the highest rates. Generally, according to the interaction between compost and rabbit manure rates, treatment zero compost with 0.9 g per cell of tray of rabbit manure had the highest significant value for stem length, stem diameter, number of leaves and fresh and dry weights and treatment 100% compost with 0.9 g rabbit manure had the lowest significant value in all evaluated characters, except chlorophyll SPAD value. Also, results revealed that microbial activities (total counts of bacteria, fungi and actinomycetes beside to dehydrogenase enzyme) recorded high significant values with increasing addition rates of either compost or rabbit manure and integrated between them.

Key words: Tomato · Transplant · Production · Organic · Compost · Microorganism

INTRODUCTION

The organic farming industry is steadily growing in the world, including Egypt. The strong market suggests that interest in organically produced agricultural goods will only continue to rise [1]. The use of transplants is the most reliable method to ensure adequate crop establishment of commercial plantings of various high-value vegetable crops in conventional and organic production. Other advantages include reduced cost over direct seeding when using expensive hybrid seed, improved land use efficiency, extension of a short growing season and improved early weed control [2]. Producing healthy transplants for organic production systems is an essential step in the process of maximizing crop yields. Successful transplant production begins with good growing media. Vegetable transplants are generally grown in soilless substrate mixes, viz., peat, pine bark, vermiculate and perlite, which can be used in disposable vacuum-molded cell packs, plastic trays, or styrofoam trays and provide growing conditions (sufficient aeration, root growth and plant support) [3-4]. All components entering into the organic crop production system must be approved for organic use, including soil media and fertilizer used in transplant production. Transplant substrates should be sterile, light-weight, friable and have adequate water-holding capacity [5]. Commercial, peat-based media approved for certified organic production are available and custom peat-based mixes that use certified organic fertilizers could also be used. Both of these options, however, are usually expensive and their sustainability is questionable given the dependence on peat, a resource generally considered to be non-renewable and processed organic fertilizers shipped long distances. Therefore, the search for alternative high quality and low cost substrates, with emphasis on reusable, recyclable materials not derived from non-renewable sources as growing media in horticulture is a need due to the increasing demand and rising costs for peat [6].

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Composting has been used to stabilize a wide variety of organic wastes or byproducts prior to their use as growing medium amendments. Waste disposal has become global concern in the world. Therefore, considerable research has been shown over the past few decades that compost, derived from various feedstocks such as bark, town refuse, sawdust, sewage sludge or spent mushroom, can be used successfully as partial and sometimes as complete, substitutes for peat in vegetable transplant production [7 - 17]. Composts may have physical, physico-chemical and chemical properties similar to peat that make them suitable as peat substitutes [9]. On the other hand, several studies have reported that composts can also show features considered as limiting factors for their horticultural use, such as the presence of hazardous components (heavy metals), poor physical properties, phytotoxicity or an excess in salts or nutrients that originate media with high electrical conductivity [8, 9, 18, 19]. Therefore, the combination of peat with composts can reduce the potential poor characteristics of single materials and the ratio of compost used will depend on characteristics of the compost [7, 14, 15, 20]. Also, the nutrient contributions are not addressed because the composts are considered only as substrate alternatives to peat. The plant-available nutrient contribution, a characteristic of high importance to organic producers, is often presumed to be inadequate.

Vegetable transplants produced organically are often of low quality because of poor fertilization management. Proper nutrient rates for transplants directly impact field performance [21]. There is limited information available on organic fertilization of vegetable transplants and there are no general recommendations for using organic fertilizers. A major challenge in organic production is the uncertainties in bio-availability of macro and micro nutrients contained in organic fertilizers or amendments. Composts are one type of organic transplant medium amendment that provide plant available nutrients [22 - 23] and can suppress plant diseases [24]. Chicken manure has a higher mineral nutrient content and higher rates of nitrogen mineralization compared to compost and can be mixed with the substrate appeared to provide enough nutrients to transplants [15, 20].

The aim of the present work was to study the effect of compost rate, as replacement to peat-moss in growing media and rabbit manure rate, as organic fertilizer, on growth and development of tomato transplants grown organically.

MATERIALS AND METHODS

The study was conducted under fiberglass greenhouse condition at Nursery Unit of the Protected Cultivation, Ministry of Agriculture, Dokki, Giza, during the 2013 and 2014 spring plantings. Tomato hybrid cv. Super Strain B seeds were sown in organic substrate, which is based on peat moss and vermiculate (1:1 by volume). The main chemical properties of the compost, peat moss, vermiculate and rabbit manure were determined according to the standard methods described by Jackson [25] and Page *et al.* [26] and the results of the analysis are shown in Table 1. The plate count using the suitable serial dilutions and specific media was applied for estimation of the examined microbial groups. Nutrient agar media was used for estimating the total count of bacteria [27]. Total fungi (actinomycetes) were estimated by Martin solid agar and Jensen solid medium [28]. Dehydrogenase activity was determined by triphenylformazan (TPF) extraction method according to Page *et al*. [26].

According to chemical analysis of these substrates, especially for salinity and total nitrogen contents, compost and rabbit manure were chosen for use in this experiment. Compost was used as a local alternative substrate for peat-moss and rabbit manure was used as a fertilizer for transplants. The experiment was a 5 × 4 factorial with a completely randomized design with 4 replicates. There were 20 growing media (treatments) obtained through combination of 5 compost rates, viz., zero, 25, 50, 75 and 100% and 4 rabbit manure rates, viz., zero, 0.3, 0.6 and 0.9 g per cell. Each replicate was one styrofoam tray having 209 conical cells (tray dimensions: 65 cm × 38 cm × 8.3 cm).

The pH of control treatment media was adjusted by adding calcium carbonate. Substrate components of mixtures were mixed in large quantities and wetted; then, the trays were filled with different mixtures and composted for 24 hr. In the two seasons, seeds were sowed on the second half of February; one seed per cell. After germination, transplants received no additional fertilizers and were grown for 5 weeks.

The final germination percentage of tomato seeds was determined by counting the number of germinated seeds after 5 weeks from sowing. Ten transplants were randomly chosen from the center of tray per treatment per replicate and harvested 5 weeks after sowing. Measurements of transplant height (taken from soil surface to top of transplant canopy), stem diameter

Table 1: Analysis of different substrates used

Substrate	Organic matter (%)	Organic carbon (%)	pH	EC (dS/m)	Total nitrogen (%)	Total potassium (%)	Total phosphorus (%)	C:N ratio
Peat moss	98.06	56.87	3.55	1.16	0.99	0.04	0.03	57.4:1
Vermiculate	1.50	0.87	8.84	0.49	0.18	0.23	0.03	4.8:1
Compost	22.78	13.21	7.28	4.56	0.99	1.18	0.30	13.3:1
Rabbit manure	67.97	39.42	8.66	2.81	2.30	1.12	0.72	17.1:1
Chicken manure	58.75	34.07	8.66	5.38	2.38	1.42	1.73	14.3:1

(at the soil surface), number of leaves, chlorophyll SPAD value in leaves and fresh and dry weights of transplants without roots (after drying for 72 h at 70°C in a forced-air oven) were recorded. Determinations of N, P_2O_5 and K_2O contents in mature tomato transplants were made 5 weeks after sowing. Total nitrogen concentration was determined by modified Nessler method [29] and phosphorus concentration was determined according to Taussky and Shorr [30] while potassium concentration was determined using absorption flame spectrophotometer according Brown and Lilliland [31].

Results of the two years were combined and the analysis of variance (ANOVA) and mean comparisons analysis were performed using the software according to Maxwell and Delaney [32]. The least significant differences (LSD) test was used for individual effect means and Duncan's multiple range test was used for interaction effect means.

RESULTS AND DISCUSIION

Effect of Compost on Germination, Physical and Chemical Properties: Both final seed germination percentage (Fig. 1) and the growth of tomato transplants (Fig. 2) were significantly affected by the presence of compost rates. Germination percentage decreased with increasing compost rate in substrates. Zero compost rate had the highest percentage of germination, while 100% compost rate was the lowest.

Stem length of tomato transplants decreased with increasing compost rate, where zero compost rate had significantly the highest stem length, while, 100% compost rate had the lowest. Compost rate 50% had the highest significant stem diameter, followed by zero and 25% compost rates, while 100% compost rate was the lowest (Fig. 2). There were no significant differences between compost rates from zero to 75%, while compost rate 100% was significantly different from the other rates. Compost rates from zero to 75% were not significantly different from each other in chlorophyll content (SPAD value), while, 100% compost rate had the highest chlorophyll content. Compost rates from zero to 50% were not significantly different from each other which had the highest transplant fresh weight followed by 75% compost rate, while 100% compost rate had the lowest fresh weight. Compost rates 25% and 50% had the highest transplant dry weight followed by zero compost rate, while, 100% compost rate had the lowest transplant dry weight (Fig. 2).

Compost rates affected NPK content in tomato transplants (Fig. 3). Nitrogen content increased by increasing compost rate, where 100% compost rate had the highest content of nitrogen, while zero compost rate was the lowest. Compost rate 25% had significantly the highest phosphorus content, while zero compost had the lowest potassium content in tomato transplants. Compost rate 75% had the highest potassium content, while 100% compost rate had the lowest content one (Fig. 3).

Effect of Rabbit Manure on Germination, Physical and Chemical Properties: Both of the final germination percentage (Fig. 4) and growth of tomato transplants (Fig. 5) were significantly affected by rabbit manure rates. Germination percentage decreased with increasing rabbit manure rate in substrates. Zero rabbit manure rate had the highest percentage of germination, while 0.9 g of rabbit manure had the lowest one (Fig. 4).

Significant differences were observed among rabbit manure rates for all evaluated traits except chlorophyll content (SPAD value), where there were non-significant differences (Fig. 5). Rabbit manure 0.6 g to 0.9 g had the highest significant stem length followed by 0.3 g, while, zero rabbit manure rate had the lowest transplant stem length. The highest significant stem diameter was observed with 0.6 g rabbit manure followed, with significant differences, by 0.3 g and 0.9 g, while, zero rate had the lowest significant stem diameter. Rabbit manure 0.6 g had the highest number of leaves followed by 0.9 g, while zero rate had the lowest number of leaves. The highest significant transplant fresh weight was produced with rabbit manure rates 0.6 g and 0.9 g, while the lowest significant transplant fresh weight was with zero rabbit manure. Rabbit manure rate 0.6 g gave the highest significant transplant dry weight, followed with significant difference, by 0.9 g, while zero rabbit manure rate gave least transplant dry weight (Fig. 5).

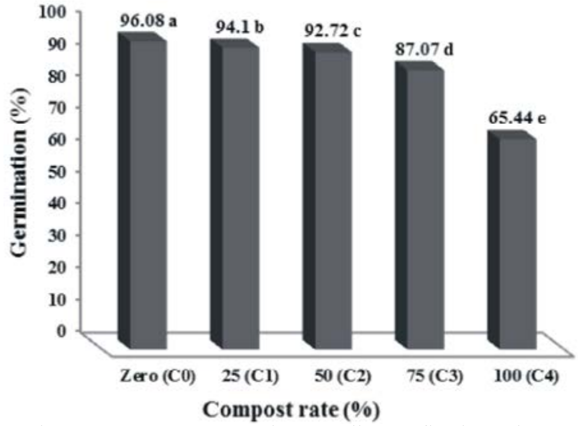

Fig. 1: Effects of compost rate in peat-compost growing media on final seed germination of tomato hybrid cv. Super Strain B 5 weeks after sowing

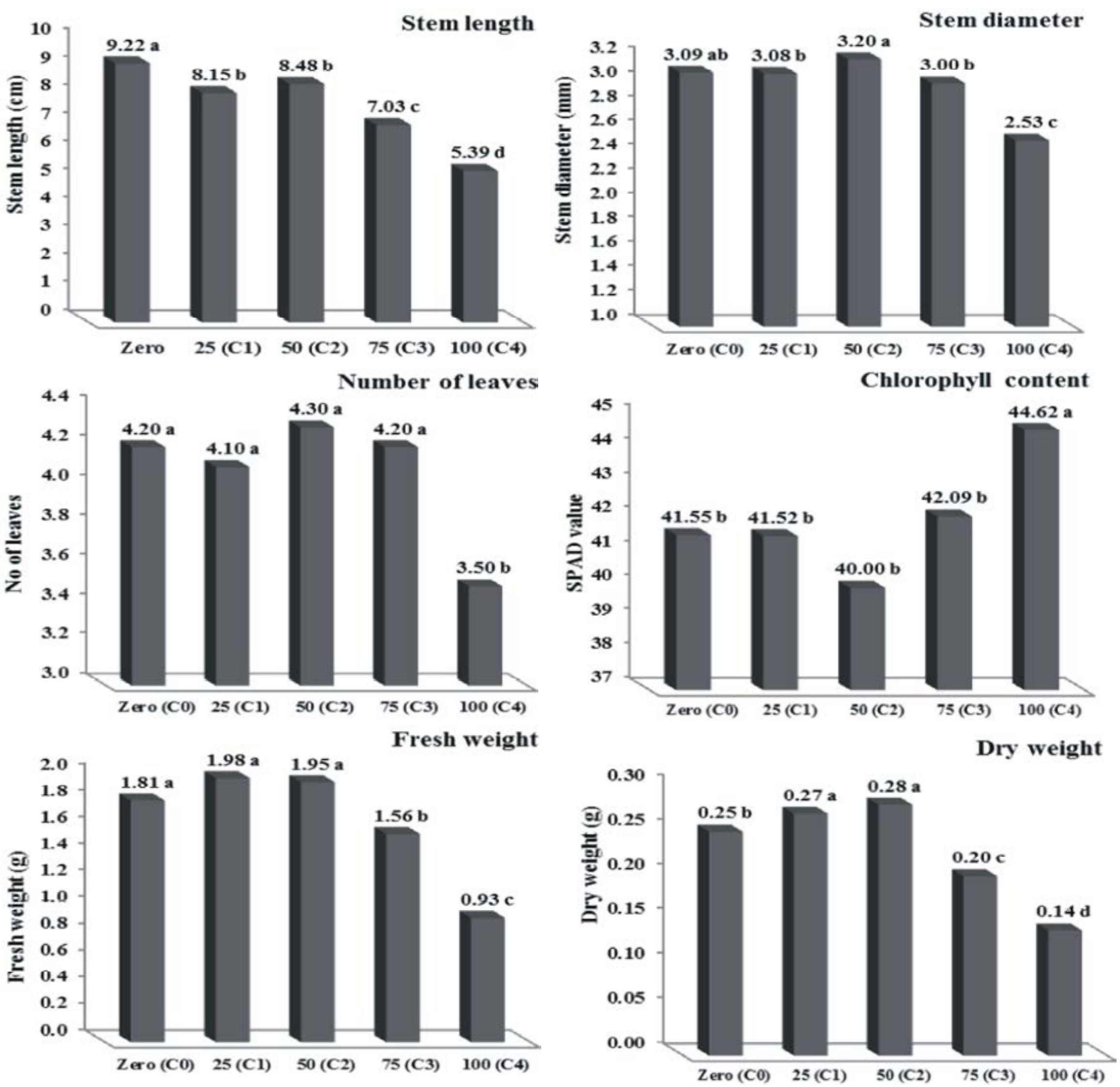

Fig. 2: Effects of compost rate in peat-compost growing medium on stem length, stem diameter, number of leaves, chlorophyll content, fresh weight and dry weight of tomato hybrid cv. Super Strain B transplants

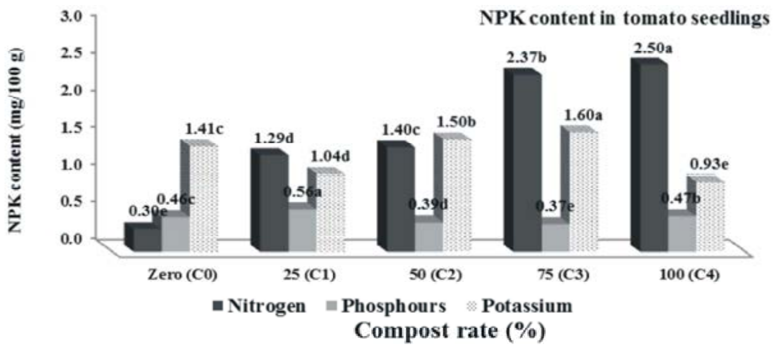

Fig. 3: Effects of compost rate in peat-compost growing medium on NPK content of tomato hybrid cv. Super Strain B transplants

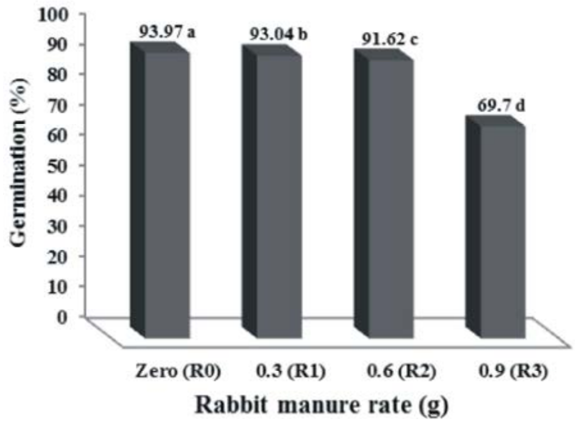

Fig. 4: Effect of rabbit manure rate in peat-compost growing media on seed germination of tomato hybrid cv. Super Strain B 5 weeks after sowing

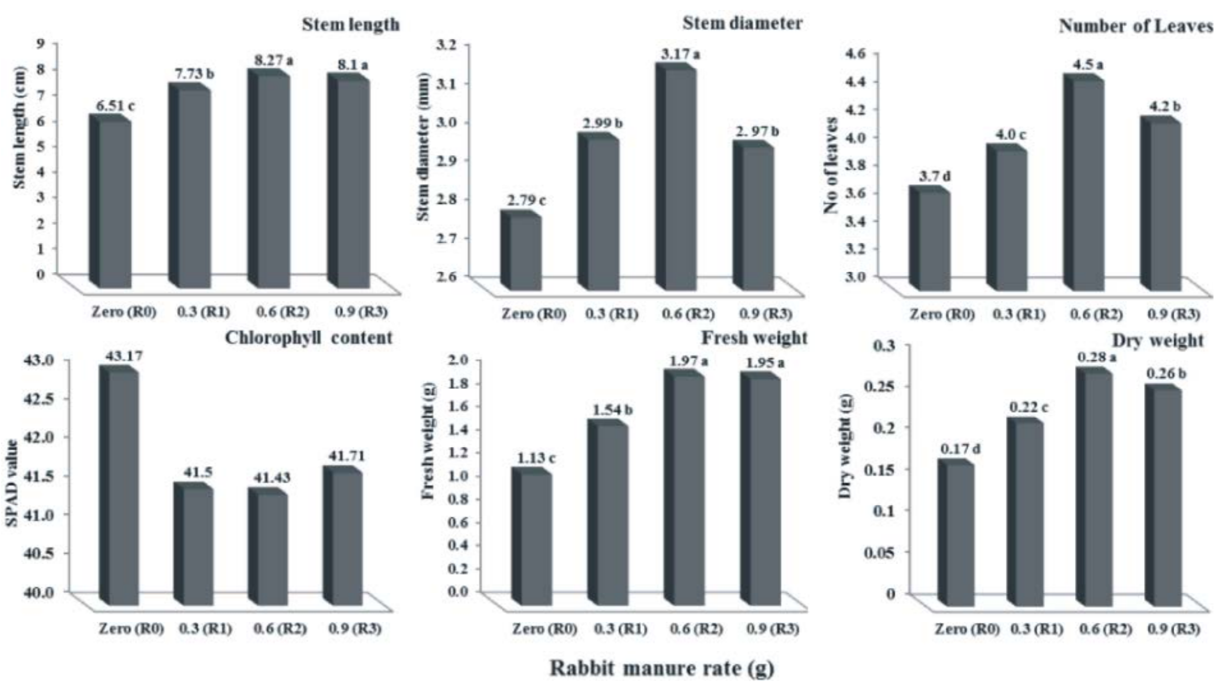

Fig. 5: Effects of rabbit manure rate in peat-compost growing medium on stem length, stem diameter, number of leaves, chlorophyll content, fresh weight and dry weight of tomato hybrid cv. Super Strain B

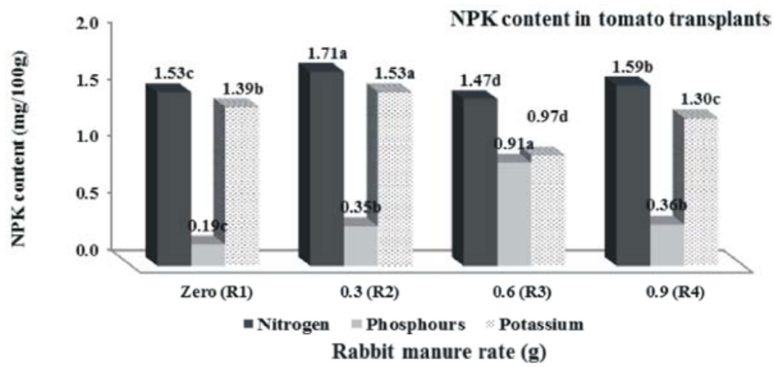

Fig. 6: Effects of rabbit manure rate in peat-compost growing medium on NPK content of tomato hybrid cv. Super Strain B

Table 2: Effect of combination between compost and rabbit manure on physical traits of tomato transplants 5 weeks after sowing

Compost rate (%)	Rabbit manure rate (g)	Germination (%)	Stem length (cm)	Stem diameter (mm)	Number of Leaves	Fresh weight (g)	Dry weight (g)
Zero	Zero	99.89 a	5.74 i	2.46 h	3.1 g	0.56 j	0.07 i
	0.3	99.83 a	10.05 a-c	3.15 b-d	4.0 d-f	1.79 ef	0.25 cd
	0.6	99.76 ab	10.36 ab	3.25 bc	4.5 b-d	2.23 bc	0.33 ab
	0.9	84.85 j	10.73 a	3.51 a	5.1 a	2.67 a	0.36 a
25	Zero	99.90 a	7.09 gh	2.82 fg	3.9 ef	1.40 g	0.22 de
	0.3	99.46 b	7.84 fg	3.09 b-e	4.0 d-f	1.90 d-f	0.26 cd
	0.6	98.25 c	8.01 f	3.13 b-e	4.3 c-e	2.15 cd	0.28 c
	0.9	78.79 m	9.66 b-d	3.29 a-c	4.4 b-e	2.46 ab	0.33 ab
50	Zero	94.80 d	7.00 h	2.96 d-g	3.9 ef	1.43 g	0.21 ef
	0.3	94.70 d	9.05 de	3.16 b-d	4.0 d-f	1.73 g	0.27 c
	0.6	93.50 e	8.63 ef	3.35 ab	4.9 ab	2.20 bc	0.33 ab
	0.9	87.88 h	9.25 c-e	3.32 ab	4.6 ab	2.42 b	0.33 ab
75	Zero	89.80 f	6.48 hi	2.95 d-g	3.9 ef	1.23 g-i	0.18 f
	0.3	88.90 g	5.60 i	2.77 g	3.9 ef	1.00 i	0.11 h
	0.6	87.70 g	7.91 f	3.22 bc	4.6 a-c	1.98 c-f	0.26 c
	0.9	81.82 l	8.14 f	3.04 c-f	4.4 b-e	2.02 c-e	0.26 c
100	Zero	85.40 i	6.26 hi	2.75 g	3.5 fg	1.02 hi	0.15 g
	0.3	82.30 k	6.13 i	2.76 g	4.0 d-f	1.24 g-i	0.21 ef
	0.6	78.90 m	6.45 hi	2.89 e-g	4.0 d-f	1.27 gh	0.20 ef
	0.9	15.15 n	2.73 j	1.72 i	2.5 h	0.20 k	0.02 j

Values followed by a letter in common are not significantly different at the 0.05 level according to Duncan's multiple range test

Macronutrient (NPK) concentrations in the aerial part of tomato transplants were significantly affected by rabbit manure rates (Fig. 6). Nitrogen content was the highest with 0.3 g rabbit manure rate, while 0.6 g had the lowest one. Rabbit manure rate 0.6 g had significantly the highest phosphorus content, while zero rabbit manure had the lowest one. Rabbit manure rate 0.3 g had the highest potassium content as compared with 0.6 g rabbit manure rate, which had the lowest content (Fig. 6).

Effect of Interaction Between Compost and Rabbit Manure on Germination, Physical and Chemical Properties: Effects for interaction between compost and rabbit manure rates on germination, physical and chemical properties of tomato transplants were significant (Tables 2 and 3). Treatment zero compost with 0.9 g rabbit manure had the highest stem length, stem diameter, number of leaves, chlorophyll (SPAD value), fresh weight and dry weight (Tables 2 and 3). No significant differences were observed between treatment zero compost with 0.9 g rabbit manure and treatments zero compost with either 0.3 or 0.6 g rabbit manure rates in stem length. Also, there were non-significant differences between this treatment and the treatments 50% compost rate with 0.6 or 0.9 g rabbit manure in stem diameter and number of leaves. No specific trend was observed with regard to chlorophyll content, while treatments 100% compost with 0.3 or 0.6 g rabbit manure had the highest chlorophyll (SPAD value). Treatment 100% compost with 0.9 g rabbit manure had the lowest fresh and dry weights.

Table 3: Effect of combination between compost and rabbit manure on chemical traits of tomato transplants 5 weeks after sowing

Compost rate (%)	Rabbit manure rate (g)	Chlorophyll (SPAD value)	Nitrogen (mg/100 g)	Phosphorus (mg/100g)	Potassium (mg/100 g)
Zero	Zero	44.36 a-c	0.32 o	0.09 m	1.50 e
	0.3	39.50 d-f	0.20 q	0.70 c	1.66 c
	0.6	39.36 ef	0.44 n	0.48 g	1.13 j
	0.9	42.96 a-e	0.25 p	0.60 e	1.35 g
25	Zero	44.30 a-c	1.01 m	0.20 l	1.34 g
	0.3	41.33 a-f	1.50 i	0.23 kl	1.26 hi
	0.6	39.11 ef	1.20 l	1.29 b	0.27 l
	0.9	41.35 a-f	1.46 ij	0.53 f	1.29 h
50	Zero	40.21 c-f	1.32 k	0.22 kl	1.27 hi
	0.3	40.42 b-f	1.52 h	0.40 h	1.44 f
	0.6	41.30 a-f	1.30 k	0.65 d	1.80 b
	0.9	38.06 f	1.45 j	0.31 j	1.50 e
75	Zero	41.90a-f	2.11 f	0.22 kl	1.25 i
	0.3	40.45 b-f	2.52 d	0.24 k	2.01 a
	0.6	41.89 a-f	2.10 f	0.66 cd	1.45 f
	0.9	44.13 a-d	2.76 c	0.35 i	1.70 c
100	Zero	45.10 ab	2.88 a	0.21 kl	1.62 d
	0.3	45.81 a	2.80 b	0.20 l	1.26 i
	0.6	45.50 a	2.30 e	1.45 a	0.22 m
	0.9	42.05 a-f	2.02 g	0.03 n	0.65 k

Values followed by a letter in common are not significantly different at the 0.05 level according to Duncan's multiple range test.

Generally, treatment zero compost with 0.9 g rabbit manure had significantly the highest values for stem length, number of leaves, stem diameter, fresh and dry weights and treatment 100% compost with 0.9 g rabbit manure had the lowest significant values for all characters except chlorophyll (SPAD value – Tables 2 and 3).

Nitrogen content in tomato transplants was significantly high with the treatment 100% compost rate + zero rabbit manure followed by the treatment 100% compost rate + 0.3 g rabbit manure, while nitrogen content was significantly the lowest with the treatment zero compost + 0.3 g rabbit manure (Table 3).

In the last decade, organic production has been the fastest growing segment in Egyptian agriculture [1]. With the increase in organic available and are usually expensive. Organic growers largely depend on compost to manage nutrient requirements of growing transplants. Using compost improved the chemical and physical properties of the growing medium.

Regarding chemical properties of all substrates (Table 1), compost and rabbit manure showed values of the electrical conductivity (EC 4.56 and 2.81 dS/m, respectively) higher than the suggested reference level (?0.5 dS/m) for an ideal substrate. Also, pH values of compost and rabbit manure (7.28 and 8.66, respectively) were higher than the acceptable pH range (5.3-6.5) [6]. The high EC and pH values of the substrates (compost and rabbit manure) had a negative impact on seed germination, prompting a decrease in the percentage of transplant emergence [33]. Also, higher salinity could not only lower germination, but also lengthen the time needed for germination [34]. Increasing compost and rabbit manure rates decreased the germination percentage (Figs 1 and 4). These results are in accordance with those obtained by Bustamanto *et al*. [14], Clark and Cavigelli [19], Gajdos [35], Garcia-Gomes *et al*. [8], Perez-Murcia *et al.* [11] and Sanchez-Monedero *et al*. [9]. The reduction in germination percentage with increasing compost and rabbit manure rates may be associated with a decrease in water retention by the substrate [36]. The increase in EC that occurred when increasing the percentage of compost and rabbit manure used in the substrate mixtures prompted a decrease in the volume of readily-available water for the transplants and a slight reduction in reserve water. These events have a negative effect on seed germination since the majority of seeds require a high level of moisture or soaking during the first 24 or 48 hours, corresponding to the imbibing process. Current practice in nurseries is based on the use of no more than one third of compost in the final mixture, since this reduces the potential risks associated with high salinity [7].

Regarding other chemical aspects of substrates, the organic matter content was lower than the level suggested by Abad *et al*. [6] for an ideal substrate (□80%) in all substrates, except for peat-moss. In general, nitrogen content was higher in rabbit manure (2.3%) followed by each of peat-moss and compost (0.99%). Also, rabbit manure was higher in phosphorus content followed by peat-moss. The C:N ratio is widely used as an indicator of the maturity and stability of organic matter. The low values were recorded here for the C/N ratio in all used substrates except peat-moss suggesting that composts were stable and mature. Davidson *et al*. [37] reported that composts with a C:N ratio of less than 20 are ideal for nursery plant production. Ratios above 30 may be toxic, causing plant death [38]. Wilson *et al*. [39] found that an increased proportion of compost in crop substrates prompted a decline in the C/N ratio compared to peats, although this will depend on the proportion of each ingredient in the mixture.

Stem diameter, number of leaves and fresh and dry weights increased with increasing rates of compost and rabbit manure reaching a maximum at 50% and 0.6 g rate, respectively and then declined at the highest rates. The use of compost and rabbit manure in the growing media elaborated influenced significantly the nutritional status of the aerial part (shoots) of the transplants. The macro nutrient contents in tomato transplants were affected by the compost proportion and rabbit manure rate used in the mixture. Nitrogen content in tomato transplants was enhanced with increasing volume of compost. These results have been reported by Garcia-Gomez *et al.* [8] and Perez-Murcia *et al.* [12] which were mainly due to the greater contribution of nutrients by the composts, especially N and P.

Increasing the rate of compost and rabbit manure, more than 50% or 0.6 g, respectively, in growing media were accompanied by a decrease in stem diameter, number of leaves and fresh and dry weights of transplants, which could be attributed to the high salinity of the substrates and that lead to delayed germination and weak growth. The reduction in transplant growth with the use of compost as substrate component has been also reported by Chong and Hamersma [18], Eklind *et al*. [20] and Sanchez-Monedero *et al*. [9] and Shiralipour *et al*. [40]. Similarly, pH can affect nutrient availability and may even induce deficiencies and toxicity [41].

Effect of Compost, Rabbit Manure and Interaction Between Them on Microbial Activity in Tomato Transplant Media: To obtain more clear indication for the effect of compost and rabbit manure and the interaction between them on microbial activities in tomato transplant media, mean total count of bacteria, fungi and actinomycetes and dehydrogenase activities were determined and their results are shown in Tables 4 and 5.

For dehydrogenase enzyme, data in Table 4 showed increasing of its activity with increasing addition rate of compost and rabbit manure relative to control (zero treatment). Dehydrogenase enzyme is an important indicator for microbial activities in rhizosphere region [42]. Thus, microbial counts correlate with dehydrogenase activity. Total counted bacteria increased from 15 to 95 × 10^7 cfu/g with the increase in compost rate. Meanwhile, zero treatment had 12 × 10^7 cfu/g. Also, total count of fungi and actinomycetes were high and ranged from 11 to 33 ×10^5 cfu/g and 18 to 80 × 10^5 cfu/g, respectively. Rabbit manure showed the same trend as the compost treatments on microbial counts. Compost and rabbit manure contains many species of microorganisms which have the ability to convert organic wastes to organic matter and stability through humification process.

Data in Table 5 reveled that total counts of microorganisms increased with high addition rates of both compost and rabbit manure. They were the lowest zero compost and zero rabbit manure numbering 12 × 10^7, 5 and 8 × 10^5 cfu/g for total count of bacteria, fungi and actinomycetes, respectively. On the other hand, the highest numbers were with high rates of compost (100%) and rabbit manure (0.9 g) that were recorded 121 × 10^7, 55 and 101 × 10^5 cfu/g for total count of bacteria, fungi and actinomycetes, respectively. Meanwhile, dehydrogense enzyme activity recorded significant increased values with gradual increase of addition rates combination of both compost and rabbit manure. It is quite evident that the greatest activities were achieved by using combination of the high rate of compost (100%) and rabbit manure rate zero or 0.9 g, as they together recorded 34.5 TPF/g/ day more than other combinations. Microbial activities increased with high rates of

Table 4: Effects of compost and rabbit manure on the change of total count of microorganisms and dehydrogenase enzyme activity in tomato transplants growing media

Factor		Total count (cfu/g) Bacteria (×10^7)	Fungi (×10^5)	Actinomycetes (×10^5)	Dehydrogenase enzyme (TPF/g/day)
Compost rate (%)	Zero	12	5	8	22.0 e
	25	15	11	18	24.8 d
	50	32	21	29	25.9 c
	75	63	28	58	29.6 b
	100	95	33	80	31.8 a
	$LSD_{0.05}$	-	-	-	0.06
Rabbit manure rate (g)	Zero	12	5	8	24.7 d
	0.3	24	8	12	25.2 c
	0.6	45	13	20	30.1 b
	0.9	65	19	29	32.8 a
	$LSD_{0.05}$	-	-	-	0.14

Table 5: Effect of combinations of compost and rabbit manure on the change of total count microorganisms and dehydrogenase enzyme activity in tomato transplants growing media

		Total count (cfu/g)			
Compost rate (%)	Rabbit manure rate (g)	Bacteria ($\times 10^7$)	Fungi ($\times 10^5$)	Actinomycetes ($\times 10^5$)	Dehydrogenase enzyme (TPF/g/day)
Zero	Zero	12	5	8	21.0 l
	0.3	25	9	12	30.0 f
	0.6	46	15	23	30.5 e
	0.9	63	21	31	34.5 a
25	Zero	17	10	14	21.0 l
	0.3	25	18	21	20.0 m
	0.6	49	26	30	24.0 j
	0.9	55	33	40	34.0 b
50	Zero	34	20	25	25.5 i
	0.3	45	25	31	27.0 h
	0.6	68	30	54	32.0 d
	0.9	75	36	65	34.0 b
75	Zero	65	25	52	23.5 k
	0.3	71	29	58	21.0 l
	0.6	95	35	65	32.0 d
	0.9	101	45	75	27.0 h
100	Zero	95	35	79	32.5 c
	0.3	103	39	85	28.0 g
	0.6	114	49	90	32.0 d
	0.9	121	55	101	34.5 a

Values followed by a letter in common are not significantly different at the 0.05 level according to Duncan's multiple range test

compost and rabbit manure may be due to their organic matter contents and macroelements which are feeding sources for microorganisms. Nevertheless, increasing compost rate about 50% and rabbit manure rate about 0.6 g negatively affected the germination of tomato seeds and seedlings growth rate due to the high level of salinity and pH value of the used substrate.

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