Composition of different composites and vermicompost and effects of their application rates on growth parameters of pot grown tomato

Teseaye Balemi

ILRI/CIMMYT-Ethiopia, P. O. Box 5689, Addis Ababa, Ethiopia.

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Two sets of pot experiments were conducted to investigate the effect of different compost types (market compost, home compost and vermicompost) and their rates on growth of pot grown tomato. During the first experiment, two compost types (market and home composts) each applied at four rates (0, 200, 400 and 800 g/pot) were evaluated while during the second experiment all the three compost types including vermicompost each applied at five rates (0, 200, 400, 600 and 800 g/pot) were evaluated. The chemical compositions of the composites were analyzed using appropriate laboratory procedures. Results revealed that market compost had the highest available P, exchangeable K and total S content whereas vermicompost had the highest organic matter and total N content followed by market compost. Growth parameters increased with increasing rates of home compost and vermicompost, but decreased with increasing rate of market compost. Shoot nutrient content varied much between compost types than compost rates. Shoot nitrogen and potassium concentration was higher with the application of market compost; phosphorus concentration was higher with the application of vermicompost while sulphur concentration was the highest with the application of home compost. Growth reduction at the highest market compost application could be ascribed to higher pH and total soluble salt content, especially chloride and potassium.

Key words: Compost, salt stress, tomato, toxicity, vermicompost.

INTRODUCTION

Disposal of organic waste is a serious challenge, especially in big cities due to absence of appropriate disposal sites and thus utilization of these wastes through composting is, now a days, given due attention as an alternative solution to the difficulties of organic waste disposal. Composting of organic waste is a low external energy input microbial decomposition process that produces mineral ions and stabilized humus like...
substance (Huang et al., 2000; Stocks et al., 2002). Vermi-composting is on the other hand, a biotechnological process of composting in which certain species of earthworms are used to enhance waste conversion and produce a better product called vermicompost (Khan and Ishaq, 2011). Vermicomposts (VC), which are produced by the fragmentation of organic wastes by earthworms, have a fine structure and contain nutrients in forms that are readily available for plant uptake (Atiyeh et al., 2000). Vegetable wastes and non-edible portions that are usually discarded during harvesting, marketing and processing can be used as very good composting materials.

Both composts and vermicomposts are being used in agricultural/horticultural production to improve soil fertility as they significantly enhance soil organic matter content (Nguyen et al., 2012). The application of composts and vermicompost poses soil aggregation and stabilizes soil structure (Khan and Ishaq, 2011), increases soil water availability and hence plant nutrient uptake (Nguyen et al., 2012). Vermicompost contains 5 times high N and 7 times higher K and 1.5 time higher Ca than the first 15 cm top soil (Parkin and Berry, 1994). According to Khan and Ishaq (2011), the exchangeable potassium content of vermicompost is 58 times higher compared to garden soil. Different types of composts may have different pH and Lazcano et al. (2009) observed higher pH for compost (9.3) than for vermicompost (6.5). Likewise, Hernandez et al. (2010) also observed higher pH (8.5) for compost than for vermicompost (7.3). The P and K contents of vermicompost were 2 and 3 times higher, respectively than that of composts.

The application of quality compost and vermicompost increased growth and yield of many horticultural crops including tomato (Bahrampour and Ziveh, 2013; Ansari, 2008; Najar and Khan, 2013). Number of leaves/plant, plant height, root length and root weight of pea grown in vermicompost media were significantly higher compared to those pea plants grown in garden soil (Khan and Ishaq, 2011). Composts improved plant growth parameters such as number of leaves/plant and leaf area, at lower doses (up to 20%) while vermicompost improved growth at higher doses (up to 100%) (Lazcano et al., 2009). On the other hand, Joshi and Pal Vig (2010) observed increased growth and yield parameters in tomato (stem diameter, plant height, leaf number/plant, total biomass/plant, yield/plant), due to vermicompost application although these parameters did not increase beyond 15% VC soil mix. Bahrampour and Ziveh (2013) also reported better growth, higher yield, fruit quality and higher tissue P, K, Fe, Zn contents of tomato grown in vermicompost compared to the ones grown in the control.

Although composts and vermicomposts, besides improving soil fertility/nutrient availability and various soil properties, are also believed to improve plant growth, the amount to be applied, however, depends on the potentially toxic nutrient ions contained within the compost since some compost become toxic when applied at higher dosage (Lazcano et al., 2009). Higher pH was one of the serious problems with using higher doses of compost and addition of phosphoric acid was recommended to minimize the detrimental effect of such composts at higher application rates (Sorgona et al., 2011).

The aim of this investigation was to determine the nutrient composition of composts and vermicompost and the optimum rates of each compost type to be applied to raise healthy and vigorous tomato seedlings.

MATERIALS AND METHODS

Source of the composts

Home and market composts were obtained from development project administered under the association of EEG (Ethiopians Educated in Germany). Market compost was composted from fresh vegetable leftover collected from Piassa/Atikltitera, in Addis Ababa city whereas home compost was composted using the leftover of vegetables used for home consumption collected from individual households in Addis Ababa city. Vermicompost was obtained from Ambo Plant Protection Research Center, division of Agronomy. The vermicompost was made from donkey faeces casted using an earthworm called Eisenia fetida also known as the red wiggler, brandling worm, dung worm, or the tiger worm.

Experiment one

The treatments consisted of factorial combination of two different compost types (Market compost and Home compost) and four application rates (0, 200, 400 and 800 g/pot). A pot of 5 L size was used for the experiment. The treatments were replicated three times and were arranged in Randomized Complete Block Design (RCBD) in the glasshouse of Ambo University. Data on plant height, number of leaves per plant and shoot and root weights were recorded.

Experiment two

The treatments consisted of factorial combination of three different compost types (Home compost, Vermicompost and Market compost) and five application rates (0, 200, 400, 600 and 800 g/pot). A similar pot size used in the first experiment was also used (5 L size) during the second experiment. The treatments were replicated 3 times and were arranged in RCBD. Data on number of leaves per plant, plant height and shoot and root weights were collected.

Plant raising and determination of plant parameters

About 8 to 10 seeds of tomato variety called Melka shola was sown in each pot and after emergence the seedlings were thinned to 2 seedlings per pot. All the plants were being irrigated as required to avoid moisture stress. After 45 days of sowing, the above ground part (shoot) was removed and the fresh weight was determined. After oven drying the same shoots at a temperature of 65°C for 48 h the dry weight was determined. The roots were extracted from the pot after washing under tap water and the fresh and dry weight were also recorded.
Measurement of the physico-chemical properties of the composts and vermicompost

**Determination of pH**

The pH of the composts and vermicompost was measured in 1:2.5 compost: water suspension as well as in CaCl₂ solution using a portable pH meter (Portamess®).

**Determination of available P and K**

Available phosphorus content in the composts and vermicompost was determined using both CAL method (Schüler, 1969) in which Calcium Acetate and Lactate (composed of calcium lactate pentahydrate, calcium acetate hydrate and acetic acid) solution was used as an extractant and the Olsen method (Olsen et al., 1954) in which sodium bicarbonate (0.5 M NaHCO₃ at a pH=8.5) was used as an extracting solution. Phosphorus concentration in the extract was measured using spectrophotometer (µQuant MQX200) at 405 and 882 nm for CAL and Olsen methods, respectively following the addition of appropriate color reagents. Likewise, the potassium content of the soil was determined both by extracting the potassium with Calcium Acetate and Lactate (CAL) solution as well as by 1 M ammonium acetate solution and was measured using flame photometer (Eppendorf Elex 6361 Flamenzphotomet).

**Determination of total N and S**

The total nitrogen and sulphur content was determined by using CNS autoanalyzer (Elementar Vario EL III) in which 20 mg compost sample was put in an aluminium foil, wrapped up and was heated up to a temperature of 1200°C using Tungston (III) oxide as a reaction catalyst in the presence of oxygen supply. Additionally, the total nitrogen was also determined using Kjeldahl method (Kjeldahl, 1883).

**Determination of organic matter (OM)**

The organic matter (OM) content of the soil was determined using two methods, Walkley and Black (Walkley and Black, 1934) and CNS methods. Organic matter content using the first method was determined at the Department of Chemistry, Ambo University, Ethiopia whereas OM with CNS method was determined at the Institute of Plant Nutrition, Leibniz University of Hannover, Germany. With the Walkley and Black method, the amount of Ferrous sulphate solution used for back titrating the excess dichromate was recorded and used for carbon estimation while with the CNS method, 20 mg compost sample was put in an Aluminium foil, wrapped up and heated to a temperature of 1200°C using Tungston (III) oxide as a reaction catalyst in the presence of oxygen supply. The amount of carbon in the sample was determined using CNS autoanalyser (Elementar Vario III). The organic matter content was calculated from the carbon content value obtained by multiplying with 1.724 with the assumption that organic matter contains 56% C.

**Determination of total salt and salt components**

Total soluble salt was estimated from EC measurement using an EC meter. Salt components such as Na⁺ and K⁺ was measured using flame photometer after extracting with 1 M ammonium acetate solution. Chloride ion (Cl⁻) was measured through back titration with HgNO₃. Ca²⁺ and Mg²⁺ were determined using inductively Coupled Plasma Mass Spectrophotometer (ICP-MS) and NO₃⁻ and NH₄⁺ was measured using nitrogen auto analyzer (SAN⁺⁺ SYSTEM). Except NO₃⁻ and NH₄⁺, which were extracted using 0.1 M KCl and Na⁺ and K⁺, which were extracted using 1 M ammonium acetate solution, all the other salt components were extracted using distilled water (1:2 compost: water ratio).

**Plant sample analysis**

After the shoot dry weight was measured, the dried plant samples were ground, and 50 mg of the ground samples was ashed overnight at 500°C and analysed for various nutrient concentration after extracting the ashed content using 1:3 nitric acid and measured using ICP-MS.

**Statistical analysis**

Data was analysed using SAS statistical software version 9.3 following PROC GLM procedure. When the Analysis of Variance (ANOVA) shows significant effects of main factor or their interaction at a probability level α=0.05, appropriate mean separation was carried out using Tukey test.

**RESULTS**

**Chemical composition of different composts**

**pH**

The market compost had the highest pH value (10 in water and 9.8 in calcium chloride) compared to both vermicompost (7.1 in water and 6.9 in calcium chloride) and home compost (8.7 in water and 8.4 in calcium chloride). The pH of the composts determined using CaCl₂ was lower by 0.2 to 0.3 compared to the pH of the composts determined in water (Table 1).

**Organic matter**

The organic matter content (OM) of the composts determined using CNS auto analyser was 1.3 to 1.8 fold higher than the OM content determined through Walkley and Black method. The organic matter content was higher for vermicompost followed by market compost. The organic matter content of vermicompost was nearly 4 times higher for vermicompost followed by market compost, respectively.

**Available phosphorus**

Home compost had the lowest available phosphorus (Av.P) content compared to the other two compost types (market compost and vermicompost). The available
phosphorus content of market compost was three-fold higher (P-CAL) and six-fold higher (P-Olsen) than that of home compost. The available phosphorus content of vermicompost (both CAL and Olsen) was two-fold higher than that of home compost (Table 1). Compared with farm soil, the available phosphorus content of market compost was 79 to 98 fold higher while that of vermicompost was up to 30 to 56 fold higher depending on the P determination method used. Likewise, the available phosphorus content of home compost was by 16 to 25 fold higher compared to that of the farm soil.

**Available potassium**

The available/exchangeable potassium content (both CAL-K and Ammonium Acetate extractable-K) of market compost was three-fold and that of vermicompost was on average 1.3 fold higher than that of home compost (Table 1). Compared to the farm soil, the exchangeable potassium content of market compost was up to 50 to 90 folds higher while that of home compost was up to 22 to 39 fold higher. Likewise, the exchangeable potassium content of vermicompost was by 18 to 29 folds higher than that of the farm soil.

**Total nitrogen**

The total nitrogen determined through CNS auto analyzer was generally higher compared to that of Kjeldahl method. Vermicompost had 1.8-fold and 1.2-fold higher total nitrogen content than home compost and market compost, respectively (Table 1). Compared to the farm soil, the total nitrogen content of vermicompost was by 4-fold higher and that of market compost was by 2.8 to 3.5 times higher.

**Total sulphur**

Unlike the total nitrogen, the total sulphur content was determined only through CNS auto analyzer. Market compost had higher total sulphur content (0.52%) than both home compost (0.38%) and vermicompost (0.36%). Compared to the farm soil, the total sulphur content in market compost, home compost and vermicompost was by 4.7, 3.5 and 3.3-fold higher.

### Interaction effect of compost types and rates on growth of tomato

The analysis of variance showed that the shoot fresh and dry weights, root fresh and dry weights as well as plant height and number of leaves per plant were significantly affected by the main effect of compost types and rates as well as by their interaction effects. For home compost, the shoot fresh and dry weights significantly increased with the increase in the application rate (Figures 1 and 2) during both experimental periods. It also increased with the increase in the application rate of vermicompost during the second experiment (Figure 2). To the contrary, for market compost the shoot fresh and dry weights decreased significantly with the increase in the application rate (Figure 1A and B) during the first experiment. During the second experiment, increasing the application rate of market compost beyond 400 g/pot, also tended to reduce shoot weights but the shoot weights obtained at the application rate of 200, 400 and 600 g/pot did not significantly differ while application at the highest rate (800 g/pot), resulted in the lowest shoot fresh and dry weight (Figure 2A and B).

For home compost and vermicompost, the root fresh and dry weights increased with increasing the application rates (Figures 5 and 6). However, with market compost, the root weights tended to increase with increase in the rates of application from 0 to 400 g/pot and sharply declined with increasing the market compost rate from 600 to 800 g/pot during both experiments. At the highest market compost rate (800 g/pot), nearly the plant did not produce extractable roots (Figures 5 and 6).

For home compost and vermicompost, increasing their application rates from 0 to 800 g/pot tended to increase the number of leaves per plant as well as plant height, while these parameters tended to decrease with an
Figure 1. Interaction effect of compost types and rates on shoot fresh (A) and dry weight (B) of tomato during the first experiment (for the same compost type. Means followed by similar letters are not significantly different from each other).

Figure 2. Interaction effect of compost types and rates on shoot fresh (A) and dry weight (B) of tomato during the second experiment (for the same compost type means followed by similar letters are not significantly different from each other).

increase in the application rate of market compost (Figures 3 and 4). At the highest market compost rate (800 g/pot), the plants was as short as that of the control where no compost was applied (Figures 3 and 4).
Interaction effect of compost types and rates on plant height (A) and number of leaves per plant (B) of tomato during the first experiment (for the same compost type means followed by similar letters are not significantly different from each other).

Interaction effect of compost types and rates on shoot nutrient concentration

The analysis of variance showed that the shoot nitrogen, sulphur, phosphorus, potassium, sodium and zinc concentration were significantly affected by the main effects of compost types and rates as well as by their interaction effects. For home compost and vermicompost,
the shoot nitrogen concentration did not vary between the application rates while for market compost the shoot nitrogen concentration was significantly higher for the tomato plants grown at higher market compost rates of 400, 600 and 800 g/pot. With both home compost and vermicompost, the application significantly increased the shoot sulphur concentration over the control (Figure 7). The shoot sulphur concentration was higher for the
tomato plants grown in home compost and vermicompost and was lower for the tomato plants grown in the market compost. Sulphur uptake was highly constrained at the highest market compost rate (shoot sulphur concentration <1.5%) while nitrogen uptake was not at the application of similar market compost rate (Figure 7). For all application rates, the shoot phosphorus concentration was generally higher (6 to 8 mg/g d.m) for vermicompost than for home compost (4.5 to 6 mg/g d.m) and market compost (4.5-5 to 5 mg/g d.m) (Figure 8A). However, the amount of available P in market compost was much higher than that of vermicompost and home compost. At
all application rates, the tomato plants accumulated sufficient P concentration in their tissue except the plants in the control pots. The K concentration in tissues of plants grown at different application rates of both home compost and vermicompost was lower or comparable to the plants grown in the control pot (Figure 8B). The K concentration in the tissues of plants grown at the highest application rate of market compost (800 g/pot) was three-fold higher to the K concentration in tissues of plants grown in the same compost at the lower application rates (200 and 400 g/pot).

The shoot sodium concentration was extremely higher (6.6 mg/g d.m) for the plants grown at the highest (800 g/pot) market compost application rate (Figure 9A). The shoot sodium concentration of plants grown at 200 and 400 g/pot of both home compost and vermicompost were not different from that of the control plants. Shoot sodium concentration tended to increase with the increase in the compost application rates and the increase was much more pronounced in the case of market compost. For the tomato plants grown in home compost and vermicompost, the shoot zinc concentration tended to increase with the increase in the application rate. However, for the tomato plants grown in the market compost, the shoot zinc concentration decreased with the increase in the application rate beyond 400 g/pot (Figure 9B).

DISCUSSION

Nutrient composition of composts

Market compost had higher pH, which might have adversely affected tomato growth at higher doses of 800 g/pot. Similarly, Sorgona et al. (2011) also reported reduced growth rate in tomato and zucchini seedlings at higher doses of compost application due to higher pH and EC. However, at lower rates (200 and 400 g/pot) of market compost application, such detrimental effect of higher pH was not observed, probably due to the fact that the high pH from the compost might have been buffered by the lower pH of the large proportion of the mixed soil. In the current study, from among the three compost types, vermicompost had the lowest pH value (7.1). Hernandez et al. (2010) also observed lower pH value for vermicompost (7.3) than for compost (8.5), which is in line with the present observation. The pH of vermicompost reported by Bahrampour and Ziveh (2013), which was 7.7 and by Kmetova and Kovacik (2013), which was 7.4 are also in agreement with what was observed in the present study. Similarly, Lazcano et al. (2009) also reported higher pH of 9.3 for compost and lower pH of 6.5 for vermicompost.

The organic matter (OM) content of all the composts was higher than that of the farm soil, which ultimately accounted for better tomato growth compared to the control. The organic matter content of vermicompost reported in the present study is higher (41.3% for OM determined with CNS auto analyser and 32.0% for OM determined with Walkley and Black method) than what was reported by Bahrampour and Ziveh (2013) for vermicompost (25.8%). Lazcano et al. (2009) reported similar organic matter content of relatively higher value (61%) in both compost and vermicompost while Hernandez et al. (2010) reported an OM content of 41.4% for vermicompost and 36% for compost, which are...
in agreement with the current study. The slight difference in the organic matter content value reported by different authors could be attributed to the difference in the materials used for composting (vegetable leftovers in the case of the present study and cow manure by Lazcano et al. (2009) and vermicomposting (which was donkey manure in the case of the present study and pig manure by Lazcano et al. (2009).

The available P, exchangeable K and total N and S contents of the composts used in the present study were also quite higher compared to that of the farm soil and have largely contributed to better tomato growth in compost and vermicompost treatments than in the control treatment.

The exchangeable K content of home and market composts as well as vermicompost were about 21, 48 and 15 g/kg, respectively with market compost having higher K content. Kmetova and Kovacic (2013) also reported an exchangeable K content of 14 g/kg for vermicompost, which is quite comparable with the K content observed for vermicompost in the current study (15 g/kg). Hernandez et al. (2010) also reported lower potassium content in vermicompost than in compost, which supports the present observation. However, Hernandez et al. (2010) observed slightly higher potassium content values for both composts and vermicompost compared to the results observed in this investigation probably due to the difference in the material used for vermi-composting/composting. Similar to the present investigation, Bahrampour and Ziveh (2013) also reported higher potassium content (10 g/kg) in vermicompost as compared to soil (31-fold higher). However, the exchangeable K content they measured was slightly lower (10 g/kg) compared to what was observed in this study (15 g/kg). In the current study, the exchangeable potassium content of market compost, home compost and vermicompost was up to 50 to 90 fold, 22 to 39 fold and 18 to 29 fold higher than that of farm soil, respectively which is in line with the results of Khan and Ishaq (2011), who also reported a 56 to 58 fold higher potassium content between compost/vermicompost and garden soil. Likewise, Kmetova and Kovacic (2013) reported 47.5-fold higher exchangeable K content of vermicompost compared to farm soil which further supports the present observation.

The total N content in this study was higher for vermicompost than for the other compost types (Table 1). Similar to the present study, Hernandez et al. (2010) also observed higher total N for vermicompost than for compost although the actual value in the current study was higher (2.02% for CNS auto analyser, 1.8% for Kjeldahl method) than what he reported for vermicompost (1.6%). The difference in the total N content value between the current study and the authors’ report might be accounted to difference in the material used for vermicomposting, cattle manure in the case of the authors and donkey manure in the case of the current study. Bahrampour and Ziveh (2013) also reported lower total N (1.3%) content in vermicompost compared to what was observed in the current study and the lower total N value he reported could be due to the difference in vermicomposting material used, sheep manure by the authors and donkey manure in the case of the current study. Compared to the farm soil, the total nitrogen content of vermicompost in the current study was by 4-fold higher, which is supported by the report of Kmetova and Kovacic (2013) who also observed 10-fold higher total N content in vermicompost compared to soil. In terms of the actual total N content, Kmetova and Kovacic (2013) reported a total N content of 2.94% for vermicompost which is closer to the current result of 2.02% total N content (Table 1).

Compared with farm soil, the available phosphorus content of market compost was 79 to 98 fold higher, that of vermicompost was up to 30 to 56 fold higher while that of home compost was by 16 to 25 fold higher depending on the P determination method used. The available P content of both compost and vermicompost in the present investigation was quite higher compared to what was observed by Hernandez et al. (2010), which were 0.14 g/kg for vermicompost and 0.16 g/kg for compost. Although there was tremendous difference in available P value between the two observations, the difference in available P content could partly be due to difference in materials used for composting/vermicomposting (cattle manure) in the case of the authors’ and donkey manure in the case of the present study. On the other hand, the available P content of vermicompost in the current investigation was lower (4.9 g/kg P-CAL and 1.2 g/kg P-Olsen) compared to what was reported for vermicompost by Bahrampour and Ziveh (2013), which was 13 g/kg, a relatively higher value. Kmetova and Kovacic (2013) also reported an available P content of 5.6 g/kg in vermicompost, which was 215-fold higher compared to that of the farm soil which supports most other reports as well as the present observation.

**Effect on plant growth**

For home compost and vermicompost, increasing the application rates from 0 to 800 g/pot increased shoot fresh and dry weights, leaf number per plant and plant height. Similarly, Joshi and Pal Vig (2010) also observed an increase in plant height and leaf number with an increasing rate of vermicompost. But increasing the application rate of market compost above 400 g/pot reduced the above growth parameters (Figures 1 and 3). Similar to what is currently observed with market compost, higher proportion of some composts relative to soil (50% each) resulted in reduced growth and even in plant mortality, while the application of higher doses of vermicompost resulted in a significantly higher plant growth compared to the application of lower doses
However, the higher market compost rate of 800 g/pot could be related to salt stress and specifically to chloride and potassium toxicity (Table 2). The higher sodium accumulation in the tissue (Figure 9) might also be another reason for growth reduction at higher market compost application.

### Effect on tissue nutrient concentration

Surprisingly, the potassium concentration in plants grown at all levels of both home compost and vermicompost was not different from that of the control (Figure 8B). Absence of such difference in tissue K concentration, despite the huge difference in the exchangeable K content between the farm soil and home and vermicompost, cannot be easily explained. However, the potassium concentration in plant grown at the highest MC application rate of 800 g/pot was considerably higher (three-fold) than that of the control (Figure 8B) and hence might have resulted in toxicity and hence reduced plant growth as suggested above. The other weird thing is that the treatment in which the shoot nitrogen concentration was higher, the shoot sulphur concentration was lower and vise versa. These relationships usually occur with nutrient having antagonistic effects and the reason for the current observation with N and S is not clear and is not easily justifiable.

In a nut shell, results of the present investigation showed that the reduction in growth parameters of tomato at the application of 800 g/pot MC seems to be related to the higher total soluble salt content (35 g/kg soil) and higher pH of the market compost (pH=10) as opposed to the other two compost types. Further investigation of the soluble salt components revealed that MC contained higher potassium and chloride content than the other compost types. This was further confirmed by the highest K concentration in the shoot tissue. Apart from the potassium, the shoot sodium concentration was also extraordinarily higher for the same treatment. Thus, reduction in growth of plants grown at 800 g/pot of MC application could also be due to salt stress and especially due to chloride and potassium toxicity and also perhaps due to Na⁺ toxicity.

### Conclusions

Vermicompost is richer in OM and total N content than the other comports while market compost is richer in available P and exchangeable K as well as total sulphur content. Increasing the rate of market compost from 200 to 800 g/pot resulted in reduction of growth of tomato plant. However, with both home compost and vermicompost, increasing the rate from 0 to 800 g/pot resulted in increased shoot fresh and dry weights, root fresh and dry weights, plant height and leaf number per plant. Unlike home compost and vermicompost, market compost, therefore, should not be applied at higher rate since it results in reducing plant growth. The reduction in growth of pot grown tomato plant with the application of 800 g/pot MC could be due to effect of higher pH and salt stress (chloride, potassium as well as sodium toxicity).

In summary, the application of compost is essential for improving growth of tomato plant however, since some compost could have toxic effects such composts as market compost should be applied at lower rate to give effective result whereas for home compost and vermicompost higher rates of application favours tomato growth.

### CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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the analysis of the composts and plant samples.

**Abbreviation**

HC, home compost; VC, vermicompost; MC, market compost; OM, organic matter; N, nitrogen; Av.P, available phosphorus; Exch. K, exchangeable potassium; S, sulphur.

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