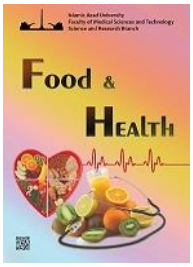

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The effect of organic fertilizers (chicken manure tea and vermicompost) on some nutritional value trace in greenhouse cucumber

Mehran Jandaghi [1], Mohammad Reza Hasandokht [2], Vahid Abdossi [1*], Pezhman Moradi [3]

[1] Department of Horticultural Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran
[2] Department of Horticultural Sciences, Faculty of Agricultural Sciences, College of Agriculture & Natural Resources, University of Tehran, Karaj, Iran
[3] Department of Horticultural Sciences, Saveh Branch, Islamic Azad University, Saveh, Iran

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ABSTRACT

Currently in order to develop healthy foods, the usage of organic fertilizers has received more consideration as a suitable suggestion for the application of chemical fertilizers. Cucumbers, a fruit in the Cucurbitaceae family, have many uses for salad as a food. This research was carried out to figure out the impact of chicken manure tea and vermicompost on some nutritional traits in cucumber fruit (*Cucumis sativus* cv. Extreme), in a greenhouse in Iran's Tehran province. The study was factorial in a randomized completely block design with four replications. Treatments were control (without any fertilizer), control with chemical fertilizer (20-20-20), vermicompost in two levels (20 and 30 %), and chicken manure tea (1/4, 1/8, and 1/12). At the end of the grown season, fruits were harvested. Some nutrients traits were measured. Results showed that increasing the amount of chicken manure tea (up to 1/8 v/v) significantly increased trace elements (Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Copper, Iron, Zinc, Manganese) of cucumber. By enhancement in the content of chicken manure tea (1/4 v/v), all traits showed the same result as treatment with chemical fertilizer. So, manure fertilizer can be used for the improvement of nutritional value in cucumber cultivation to produce healthy foods.

1. Introduction

Cucumbers, a fruit in the *Cucurbitaceae* family, have many uses for salad as a food. They include high amount of lignins, vitamin K, cucurbitacins, and their formative (triterpenoids), flavonoids (apigenin, luteolin, quercetin, and kaempferol), antioxidants such as beta carotene and vitamin C, and B vitamins, among other trace elements and minerals (1). Since cucumber is applied as a fresh product, the chemicals, and residual toxins, remains in the organic seedlings are very significant. Conceivable use of organic agricultural wastes and super absorbent are essential in the inhibition of environmental impacts of agricultural nutritional value. Compost has been reported as a vermicompost aqueous extract including many elements of organisms, such as bacteria and fungi. The aqueous vermicompost extract is used to modify better growth and yield of organic cultivation. Manure compost has been widely used, as it is extremely available at a low price (2). In this regard, the use of organic fertilizers such as animal fertilizers or compost has stated particular notice to sustainable agricultural enthusiasts; on the other hand, this procedure can decrease their concerns regarding the accumulation of hazardous waste in the environment and human health (3). Hence, the present study was assumed to estimate the influence of an effective combination of chicken manure tea and vermicompost on some nutritional parameters in cucumber.

2. Materials and methods

This experiment was done in commercial greenhouse to cultivate cucumber located in Tehran province (35.6892° N, 51.3890° E). Seeds were prepared by Kimia Company. Chicken manure and vermicompost were mixed with tap water in a ratio of 1:4 (v/v) in polyethylene non-degradable 25 L containers at room temperature for a brewing period lasting 2

*Corresponding author: Department of Horticultural Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.
E-mail address: abdusivahid@gmail.com (Vahid Abdossi).

days. Next, the liquid was filtered through double-layered cheesecloth to obtain the aerated compost tea (ACT) and the vermicompost teas (VT), which were both kept in dark polyethylene containers at room temperature for 15 days before use. The pH and electrical conductivity (EC) were determined by using a CRISON pH-meter and a CRISON EC-meter (dS/m), respectively. The culture medium was prepared based on 75% coco-peat and 25% perlite and was poured into pots of seedling size. Pot size having a height × width (7.5 x 10 cm; 1500 vol.) was used. Bottoms were made of PVC plates and drilled with five equidistant holes (0.5 cm diameter) to allow for drainage. Pots were filled with 7-8 cm of the substrate. In each pot, two seeds were sown. Irrigation was carried out daily. From the fourth day, the seeds began to germinate. Before opening the cotyledon leaves, manual tinting was done. On the fifth day, almost all true leaves emergence in all pots. Then the desired composition was used via soil application. The experiment was arranged in a randomized complete factorial block design with factors including (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)] and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V). Treatment was applied for other pots for the next step. At the end of the grown season, fruits were harvested. Some factors such as total N were determined by a LECO-device analyzer. Phosphorus (P_2O_5) was determined by the Bray method and potassium (K_2O) by the ammonium acetate method. Total magnesium (Mg), calcium (Ca), iron (Fe), copper (Cu), zinc (Zn), manganese (Mn) were determined by using inductively coupled plasma atomic emission spectroscopy. The analysis was performed on data using SPSS 18. Comparisons were made using one-way analysis of variance [ANOVA] and Duncan's multiple range tests. Differences were considered to be significant at $p \leq 0.05$.

3. Results and discussion

Analysis of variance (Table 1) shows the effect of treatment on traces at 1% level. The control group showed a statistically significant difference with other treatments. According to Table1, the effect of treatment of chicken manure tea and vermicompost was significant on N content at 1% level. The control group presented a remarkable significant difference with other treatments. Control treatment with 150 mg/100g F.W, the smallest level and chicken manure tea 1/8 (v/v) have the highest value. Data displayed that N quantity was enhanced significantly during the time due to treatment. The highest N was seen in the treatment with chicken manure tea 1/8 (v/v)

Table 1. Analysis of variance of elements.

SOV	DF	Zn	Fe	K	Mg	Cu	Ca	Mn	P	N
Rep	2	0.08	0.06	0.5	0.8	0.21	0.06	0.03	0.08	0.02
Treatment	6	0.45*	2.39*	12.35*	5.96*	3.69*	4.87*	5.14*	3.12**	8.09*
CV	-	7.2	10.10	8	10.02	7.4	13	13	12	9.2

250 mg/100g F.W. (Fig. 1). Nitrogen is unique among major nutrient elements in that soil reserves are almost entirely in the organic form. The quantity and nature of soil organic matter accordingly, have a very significant influence on the availability of this element to growing plants (4). The stem also may represent a huge volume for the storage of photosynthetic materials and then the remobilization of photosynthetic materials into fruits. Some growth regulators such as IAA (auxin) have increased fruit quality by using organic fertilizers (5, 6). The results of this study agree with those observed in *Crassandra undulaefolia* (5), radish (6), *Calendula officinalis*, and strawberries (7). Chicken manure tea treatment (1/8 v/v) with (38 mg/100g F.W), has the highest P content; whereas the lowest result (25 mg/100g F.W g) was obtained in the control treatment (Fig. 2). Phosphorus (P) is one of the most abundant elements and is essential for plant growth, so is an important component of fertilizers for crops grown in most regions (8). Phenologists and plant nutritionists are therefore interested in the adsorption and desorption of P in the soil at both the local and international scale. The researches indicated that increased soil organic matter led to increases in the soil available P and the P activation coefficient. It has been found in many studies that organic substances can increase the availability of P in P-fixing soils and that organic substances increase the bioavailability of P applied in fertilizers (9). Wei et al. (10) provided new insights into the theoretical basis of the relationship between the nutritional contents of goji fruits and phosphorus fertilizer level. Our result is consistent with Medeiros study (11).

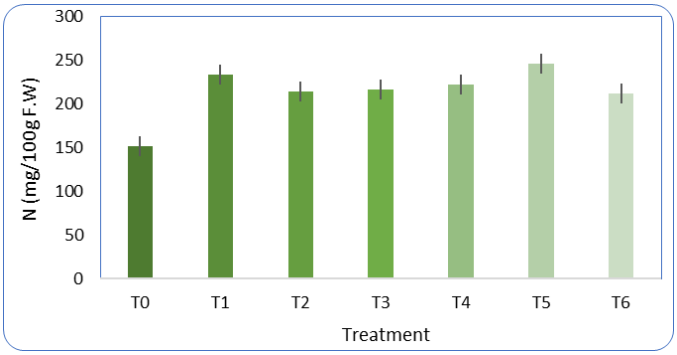

Fig. 1. Changes in cucumber Nitrogen content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

The fertilization with N and P increased the values for most of the studied variables. At the highest doses of N and P, K stimulated strawberry plant yield. The results showed that the highest amount of K (249 mg/100 g F.W) was related to

treatment with chicken manure tea (1/8 v/v) (Fig. 3). The organic manure is very helpful in supplying potassium to soils on long-term basis. The addition of manure released the nutrients more slowly and available to plant for a longer time which eventually improved the root development and enhanced the crop yield (12).

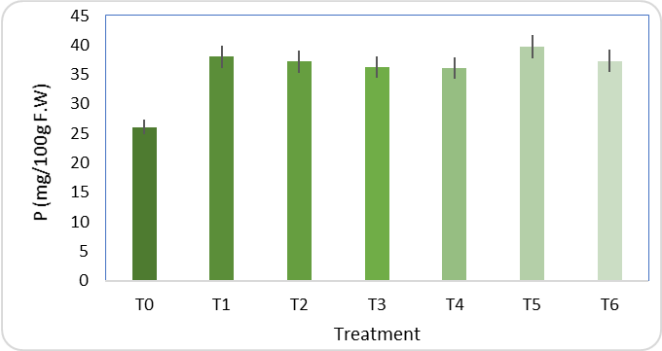

Fig. 2. Changes in cucumber Phosphorous content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

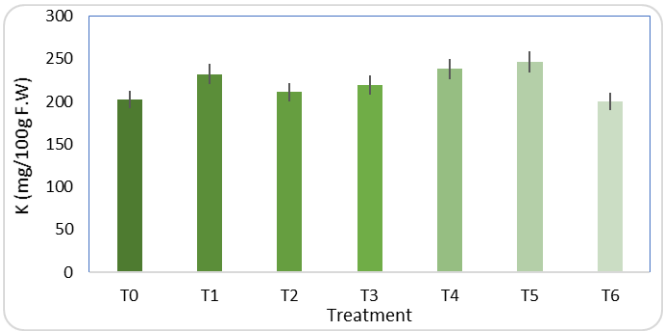

Fig. 3. Changes in cucumber Potassium content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

The higher organic manure increased the availability of potassium that played important role in the transportation of assimilates to fruits (13). The lowest amount of Zn (0.14 mg/100g F.W) was reported in the control group. Chicken manure tea (1/8 v/v) was the ones with the highest Zn content (0.19 mg/100 g F.W) (Fig. 4). While control treatment had the lowest Fe values (0.16 mg/100 g F.W), chicken manure tea (1/8 v/v) had the highest rate (0.24 mg/100 g F.W) (Fig. 5). Our data results agree with the study of (14) on pepper which indicated that the addition of organic manures (biogas and compost) at different levels enhanced the N, P, K, Fe, Zn, and Cu uptake by pepper fruits, with the superiority of compost for N, I1 and K and biogas for Fe, Zn, and Cu. A comparison of the mean Ca showed that the maximum rate (15 mg/100 g F.W) was presented in chicken manure tea (1/8 v/v) (Fig. 6). Cucumber fruits treated with the same showed greater Mg (16 mg/100 g F.W) than plants in the other treatments (Fig. 7). When organic matter is added part of free available calcium may have been adsorbed into colloidal sites of humic substances present in organic matter.

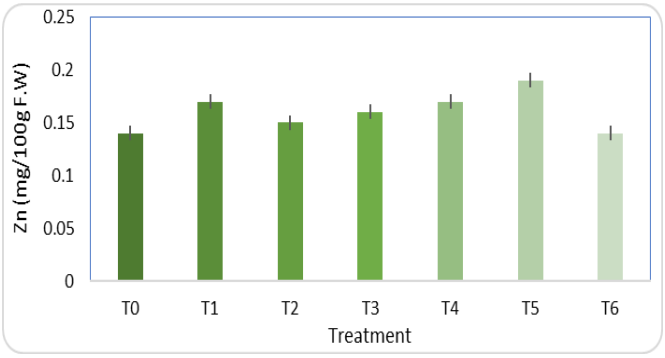

Fig. 4. Changes in cucumber Zinc content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)] and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

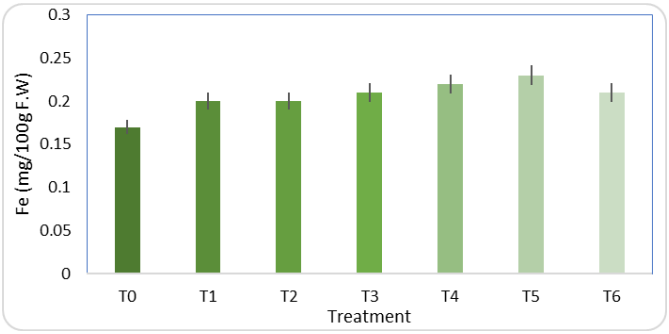

Fig. 5. Changes in cucumber Iron content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

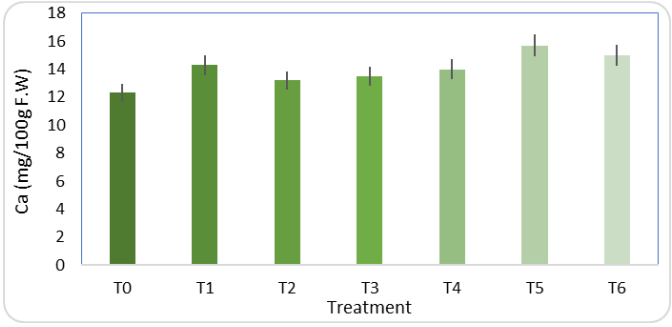

Fig. 6. Changes in cucumber Calcium content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

As a result, entry of calcium into the plants under the condition of treated organic matter may have been increased (15). Increasing Mg supply on Mg-deficient sites tends to

increase the quality of agricultural crops, particularly when the formation of quality traits is dependent on Mg-driven photosynthesis and assimilate translocation within the plant.

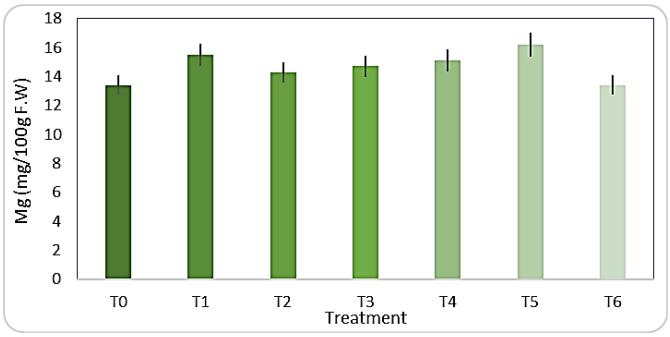

Fig. 7. Changes in cucumber Magnesium content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)], and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

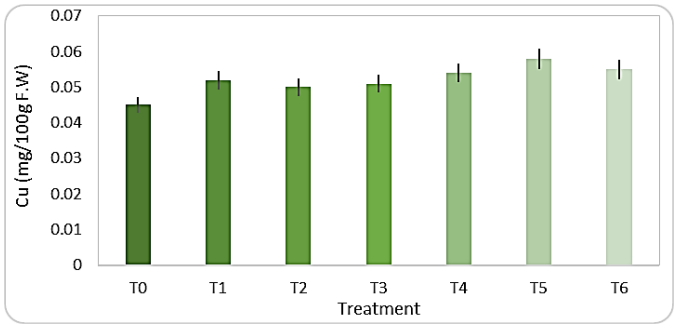

Fig. 8. Changes in cucumber Copper content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)] and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

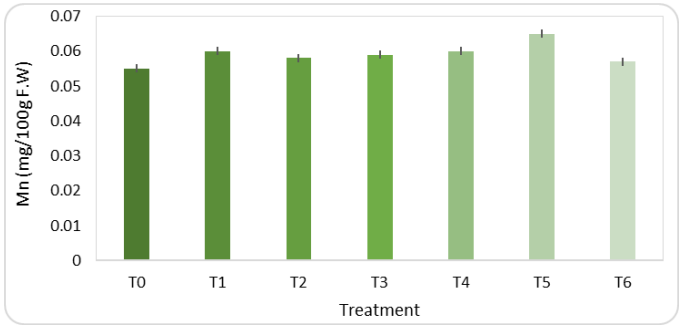

Fig. 9. Changes in cucumber Mn content supplemented with different treatment; [error bars indicate standard deviation]. (T0): without any fertilizer, (T1): chemical fertilizer (20-20-20), (T2, T3): vermicompost [20 and 30 % (V/V)] and (T4, T5, T6): chicken manure tea (1/4, 1/8 and 1/12 (V/V).

In fruits and vegetables, ratios of Mg to other nutrients like Ca and K were shown to be a more reliable indicator of the quality response than the Mg status alone. Moreover, it is concluded that Mg doses beyond those required for maximum yield rarely induce a further improvement of product quality (16). These results are partially in harmony with those obtained by Hussein (2008) (17) who found that fruit N, P, K, Ca, and Mg in Khalas date palm increased with the addition of organic manure. The highest Cu is associated with the application of chicken manure tea (1/8 v/v) (0.058 mg/100 g F.W) (Fig. 8). In addition, the amount of Mn in similar treatment is higher than other treatments (0.067 mg/100g fresh weight) (Fig. 9). The stronger correlations obtained between low-molecular-weight organic acid-extractable Cu in soil and the Cu concentrations and Cu uptakes by the plants show the suitability of this soil extraction method for predicting Cu available to spinach plants (18). The study revealed that a combination of fertilizers improved fruit nutrient content of N, P, K, Ca, Mg, Fe, Zn, Mn, and Cu.

4. Conclusion

In conclusion, results indicated that chicken manure tea on (1/8 v/v) at medium volume could be increased successfully cucumber nutritional value because elements compound enhanced. Also, manure fertilizer can be used for the improvement of cucumber cultivation to produce healthy foods.

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