

COMPARATIVE EVALUATION OF ORGANIC FERTILIZATION OF TOMATOES CULTIVATED IN PLASTIC HOUSE

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ABSTRACT

Organic fertilization is an important practice in organic farming. The objective of the present study was to evaluate the performance of compost and vermicompost in improving land productivity and tomatoes yield (variety Sandra). A plastic house experiment was conducted for the season 2010-2011 at the site of composting, National Center for Organic Farming, Ministry of Agriculture. The plastic house was divided into three blocks. Five treatments were randomly assigned to each block; T1: recommended chemical fertilizer (RCF), T2: 10 ton compost/ha + $\frac{1}{2}$ RCF, T3: 20 ton compost/ha + $\frac{1}{4}$ RCF, T4: 30 ton compost/ha, and T5: vermicompost at a rate of 2.5 ton/ha. The mixtures of compost, compost+chemical fertilizer, or vermicompost were incorporated with the upper 0-20 cm of each plot. The experimental design was a Randomized Complete Block Design in three replicates. The plastic house was supplied with drip irrigation system. Control of pest was carried out during plant development. In the present study, materials permitted by the rules of organic farming were used to control pests and diseases. Results indicated that no significant differences were found among the yield means. However, the highest yield (186.3 kg/plot) was obtained for T3 and the lowest (162.7 kg/plot) for vermicompost. Generally, replacement of chemical fertilizer with varied rate of compost or vermicompost produced beneficial effects on plant growth parameters. The levels of NH_4 (52.5-73.6 mg/kg) and NO_3 (45.5-88.8 mg/kg) during season (mid) and post-harvest (end) remain high in treatments received organic fertilizers. The magnitudes of Extractable P increased during mid-season and reached the range 22.5-34.5 mg/kg. Different behavior was observed for soil P at the end of season where Ext. P was the highest and different significantly for T5 followed by T3. The use of 30 ton compost/ha (T4) and 2.5 ton vermicompost/ha (T5) resulted in the highest Ext K at mid-season and differed significantly from the other treatments. Nearly similar trend was observed for Ext K at the end season where the highest values exhibited by the compost and vermicompost. These results indicated that organic fertilization maintained high levels of macronutrients during the growing season of tomato and post-harvest.

INTRODUCTION

Organic matter additions to soil have long been considered important in maintaining the quality of managed soils, principally because of their role in providing nutrients and in improving soil physical, chemical, and biological properties. However, the chemical fertilizers are indispensable for the crop production, but continuous use of chemical fertilizer accelerates the depletion of soil organic matter and impairs physical and chemical properties of soil (24). The quality of conventionally and organically grown foods has been reviewed by Woese et al. (40).

They identified some differences in quality between products of the two fertilization systems. Brandt and Molgaard (6) stated “organic plant foods may in fact benefit human health more than corresponding conventional ones”. Furthermore, conventional agriculture frequently relies on targeted short-term solutions to solve nutritional problems e.g. application of a soluble fertilizer. Also, Sinha et. al. (31) have indicated that a significant decline in the nutritive values of food produced by agrochemicals in the wake of ‘green revolution’. In contrast, organic systems use a strategically different approach, which relies on longer-term solutions (35).

It has been a widespread concept, particularly in the field of organic farming that soil organic matter plays a major part in maintaining soil quality. Further, it is frequently claimed that without adequate levels of soil organic matter the soil will not be capable of functioning optimally (13). Although often an increase in soil organic matter is observed as a result of organic materials application, the accumulation rates differ widely and no general relationship between the amount applied per unit of time and the rate of accumulation can be found (39). Increases of soil organic matter as a result of compost application has been reported by many authors (e.g., 29). The organic matter produced during composting can be beneficially added to soil to supply nutrient such as N, P, K and essential micronutrients to crops (18). Soil properties, such as structure and water holding capacity, which favors root growth and increase drought tolerance of crops, can be improved (19).

For available nutritional elements such as N, K, P, Ca, and Mg increased when compost was applied (8, 10). Sanchez et al. (32) suggests that the key to increasing the capacity of the soil to supply N to a growing crop is the addition of a diverse range of substrates to the farming system. Improved management of manures and composts has the potential to improve crop nutrition in organic farming. Depending on compost properties as well as on soil and cultivation conditions the immediate N effect of compost amendments in the first year amounts range between 5 and 15% of the total N in the composts, and in each of the following years from 2 to 8 (27).

Crop growth, yield and product quality in relation to application of agro waste composts had been widely reported. For instance, significant higher yields of field-grown cabbage and onion when the soil was fertilized with 25% compost have been reported (1). Togun et al. (37) observed a significant increase in fruit yield of tomato with combined application of 2 ton/ ha compost. Maynard and Hill (23) found that a combination of leaf compost and a reduced rate of 10-10-10 (N-P-K) fertilizer produced optimum yield of most vegetables including tomatoes. The fortification of compost with a small amount of mineral fertilizer almost doubled the number of tomato fruits per plant compared to the control (38). The study by Stoffella and Graetz (36) on sugar cane compost found higher marketable tomato fruit yield and fruit size in compost amended plots than unlamented. The control was not amended with fertilizer or compost and produced a total of 2,156 kg/ha with an average fruit size of 108 g/fruit and the compost amended plots without fertilizer produced a total of 36,656 kg/ha with a fruit size of 177 g/fruit.

Several authors have assessed the positive effects of compost application include the reduction of weed germination and number of plant pathogens (33), increase in yield quality and development of edaphic microorganism communities (9). Compost application reduced plant diseases and subsequently

reduced pesticide use (20). During decomposition, microorganisms such as facultative and strict aerobic bacteria, fungi, and actinomycetes, will assimilate complex organic substances and release inorganic nutrients (17). Proper composting stabilizes the composted organic carbon, as well as killing potential crop pathogens before the resulting compost is applied in the field (28).

There is need for research efforts on suitability of different agro-wastes as fertilizer and the quantity required for optimum development of crop vegetative and reproductive phases. The present study aimed at evaluating the performance of compost generated from agricultural waste and vermicompost in improve land productivity and tomatoes yield.

MATERIALS AND METHODS

Experimental Site

The area under investigation is located in Kut nearly 160 km southeast Baghdad, Iraq with coordinates of 32° 29' 44" N, 45° 48' 46" E and elevation of 22.2 m. The study was carried out for the season 2010-2011. The soil texture is a silt loam and classified as a topic torifluvents suborder. The mean soil electrical conductivity was 4.3 dS/m and of range of 1.0-9.8 dS/m and a pH of 7.9. Organic matter content in the upper soil did not exceed 1.5%. Detailed characteristics of the cultivated soil are given in Table (1).

Table 1: Some physical and chemical characteristics of the soils

CHARACTERISTICS	VALUES
Clay (g kg^{-1})	220
Silt (g kg^{-1})	230
Sand (g kg^{-1})	550
Soil Textural Class	Silt Loam
EC (dS/m)	2.4
pH	7.9
Lime (g kg^{-1})	26.4
Organic Matter (g kg^{-1})	0.52
Cation Exchange Capacity (cmol kg^{-1})	26.5
Soluble ions (cmol kg^{-1})	
Ca ⁺⁺	81.2
Mg ⁺⁺	36.9
Na ⁺	12.8
K ⁺	12.5

Production of Compost:

Compost is a biological decomposed organic material that can be used as a soil amendment. It is the controlled biological decomposition and conversion of solid organic material under aerobic conditions into a humus-like substance (22). It is created by combining organic wastes (e.g., straw, corn cob, date palm wastes, manures, etc.) in proper ratios into piles. The used compost in the study was made at the "Composting Site, Wasit, National Center for Organic Farming, Ministry of Agriculture". The main steps in production of compost was mixing the shredded waste (wheat straw), 3-5 cm in diameter with animal manure, adding activated solution (mixture of recently cultivated soil and N-P fertilizer), moisten the materials and making a pile nearly 1.7 m high and 2-3 m width. During decomposing, the water content was 50-60%, and the pile should be turned (aerated) every 10-15 days for supplying oxygen and maintaining aerobic conditions. The finished compost was ready after 70 days. Details of the process are found in publications of the National Center for Organic Farming, Ministry of Agriculture. Chemical and physical characteristics of the used compost are given in Table (1).

Application of Compost, Treatments, and Tomatoes Plantation

A plastic house of 49 m x 8 m (392 m²) was divided laterally into three parts leaving a space of nearly 1.5 m between the parts where each part represents a block. The block of 15 m length was divided into five plots with 60 cm width. Therefore, the area of each plot was 15 x 0.6 = 9 m² which represents the experimental unit.

Five treatments were randomly assigned to each block; T1: recommended chemical fertilizer (RCF) (the common doses adopted in the area) (50 kg DAP + 10 kg Urea + 2 kg Potassium Sulfate/plastic house), T2: 10 ton Compost/ha + ½ RCF, T3: 20 ton Compost/ha + ¼ RCF, T4: 30 ton Compost/ha, and T5: vermicompost at a rate of 2.5 ton/ha. Treatment 1 (RCF) is considered as a Control treatment, since the conventional practice for plastic house cultivation is using the recommended chemical dose. The vermicompost is an exported material and referred to the compost produced by earthworms and widely used worldwide (e.g., 31). Some characteristics of the vermicompost are given in Table (2). The mixture of compost, compost+chemical fertilizer, or vermicompost was incorporated with the upper 0-20 cm of each plot. The Urea was divided in two parts; the first one was added after two weeks and the second after one month of transplantation. The experimental design was a Randomized Complete Block Design in three replicates.

Table 2: Some chemical and physical characteristics of compost and vermicompost.

CHARACTER	COMPOST	VERMICOMPOST
EC (dS/m)	3.5	1.3
pH	7.2	6.8
Total-N (%)	2.1	2.3
C (%)	50	50
C/N	23.8	21.7
P (%)	0.65	2.2
K (%)	1.8	2.1
Ca (%)	2.3	2.5
Mg (%)	0.75	0.61
Water content (%)	35	36
Bulk Density (kg/ton)	650	660
Porosity (%)	40	42

Tomato (*Lycopersicon esculentum*) seeds, variety “Sandra” were sown on 6-9-2010 in trays placed in nursing shade and the seedlings were transplanted to the plastic house on 21-10-2010 in two rows (overlapped) in each plot. The distance between plants was 60 cm and between rows was 40 cm.

Agricultural practices and nutrients measurement during season

The plastic house was supplied with drip irrigation system. Irrigation was performed every week during most of growing season. The source of irrigation water is the Tigris river with EC = 1.2 dS/m. As the plants grew, lateral shoots were manually removed and poles were employed to support single stem on 4-11-2011.

Control of pest was carried out during plant development. In the present study, materials permitted by the rules of organic farming were used to fight pests and diseases. Two pheromone traps were installed in the plastic house. The total number of insects cached during the season was 540. Several pests were observed including infection of seedlings by *Verticillium* (a wilt), leaves borers, early blight, and slight infection only on the leaves at later stage by *Tuta absoluta*.

A chemical pesticide (Clazer and Tobsin) was used to control the wilt. Also, the chemical pesticide Lepi-Gold and Gold-Clean was used to control the *Tuta absoluta*. However, the Oil Neem mixed with Summer Oil was used to control the *Tuta absoluta* at late stage of plant development. The bioagent, Trichoderma was used to control insects.

Harvest of tomatoes yield was started on 6-3-2011 and continued to the end of season (20-5-2011). At the end of season, estimation was made for the length of plants (average of 20 plants/plot), stem diameter (average of 20 plants/plot), and weight of fruits for plant (average of 5 plants).

Soil samples were taken from 0-20 cm and 20-60 cm soil depths over each plot at preplant (before), mid-season (mid), and post-harvest (end). The samples were air-dried for analysis using the general procedures described by Black et al. (4). Available P was determined by ammonium molybdate/ammonium vanadate method and color was developed in soil extracts using the ascorbic acid blue color method. Exchangeable K was extracted using ammonium acetate and determined on flame photometer. Mineral N is determined using KCl as the extracting solution. Ammonium and NO_3 are determined by steam distillation of ammonia using heavy MgO for NH_4 and Devardo's Alloy for NO_3 . Organic matter was determined by Walkley-Black dichromate digestion method.

RESULTS AND DISCUSSION

Tomato' plant growth parameters and yield

Effect of compost and recommended chemical fertilizers (RCF) on number of plants per plot and growth parameters of tomato including plant length (plant height), stem diameter, and fruits weight per plant is presented in Figure (1). No significant differences were found among the number of plants in each plot. The number of plants per plot was in the range 57-61. For plant growth parameters, there were significant differences only in plant length with the highest were for T3 and the lowest for T1. In general, application of full recommended chemical dose (RCF) or replacing $\frac{1}{4}$ or $\frac{1}{2}$ of RCF was sufficient in obtaining non-significant differences for stem diameter or fruits weight per plant. However, the yield attribute of tomato (fruits weight per plant) showed the highest 30.3 kg for T4 (30 ton compost) and the lowest (26.3 and 26.4) for T5 (vermicompost) and T1 (full RCF). These results are in line of Lazcano et al. (21) data where they found that compost and vermicompost were adequate substrates for tomato plant growth in potting experiment. In addition, low doses of compost (10 and 20%) and high doses of vermicompost produced significant increases in aerial and root biomass of the tomato plants and improved significantly plant morphology.

Considering the total yield of tomato, Table (3) presents the yield for the five treatments. No significant differences were found among the treatments. However, the highest yield (186.3 kg/plot) was obtained for T3 (20 ton compost + $\frac{1}{2}$ CF) and the lowest 162.7 kg/plot for vermicompost. The application of compost and chemical fertilizers individually or in combination produced comparable yield of tomato. Generally, replacement of chemical fertilizer with varied rate of compost or vermicompost produced beneficial effects on plant growth due to the improvement in the bulk density of the growing media, total porosity, and amount of readily available water (3, 16). Similar trend of result was found by Togun et al. (37) on the effect of 2-6 ton/ha compost on tomato yield where they found the best yield by the application of 4 ton/ha. Also, Patil et

al. (30) reported that organic and inorganic fertilizers significantly contribute for producing higher number of leaves of tomato.

Table 3: Means comparison of tomatoes yield for the plots of 9 m² based on least significant differences (lsd)

TREATMENTS	YIELD (KG/PLOT) ⁺
Recommended Chemical Fertilizer (RCF)	171.7 a
10 ton Compost/ha + ¼ CF	170.9 a
20 ton Compost/ha + ½ CF	186.3 a
30 ton Compost/ha	174.3 a
2.5 ton/ha Vermicompost	162.7 a

+ Means in column with the same letter are not significant different based on lsd (p = 0.05).

Total number of tomato plants and total yield in the plastic house (in the three blocks) are given in Table (4). The plastic house of nearly 400 m² with a total number of 877 plants produced a total tomato yield of 2,597.5 kg. This amount is comparable with the yield of plastic houses in the area (11,2). However, the yield of the treatments slightly varied depending on doses of compost and chemical fertilizers. The highest yield exhibited by T3 which increased by 9% over T1 (RCF) followed by T4 with increase of 1.4%. The other two treatments (T2 and T5) showed slightly less yield as compared with T1. Macro-nutrients status and electrical conductivity.

Table 4: Total number of tomato plants and the total yield in the plastic house (in the three blocks)

TREATMENTS	TOTAL NO. PLANTS ⁺	TOTAL YIELD ⁺	%RELATIVE YIELD (INCREASE OR DECREASE)
Recommended Chemical Fertilizer (RCF)	167	515.1	0
10 ton Compost/ha + ¼ RCF	184	512.7	- 0.05
20 ton Compost/ha + ½ RCF	180	559.0	+ 9.0
30 ton Compost/ha	171	522.7	+ 1.4
2.5 ton/ha Vermicompost	175	488.0	- 5.3
Grand Total	877	2,597.5	

+ Total number of plants or total yield in the plastic house (in the three blocks).

Soil nutrients of NH₄ and NO₃ at planting, mid-season and post-harvest are presented in Figure (2). It seems that there was sufficient available N at planting (NH₄ before and NO₃ before) in all plots although there was significant difference among treatment with maximum mean exhibited for the plots of T2. Similarly, the levels of NH₄ and NO₃ during season (mid) and post-harvest (end) remain high. Therefore, both compost and vermicompost were able to supply crop needs from soluble forms of N during plant development. In this respect Lazcano et al. (21) confirmed that transformation processes on a low level, N immobilization and mineralization are almost in balance. The NH₄-N and NO₃-N of mature composts can thus be considered as almost completely plant available in the year of application. For NH₄, the vermicompost showed the highest value 78.3 mg/kg at the end of season. These results are in line of finding of Eghball (15) who indicated that compost provides soils nutrients that are beneficial to crops for many years and found that 12% of compost N was mineralized the first year, 12% the second year, and 8% the third year. In general, nitrogen in ammonium status showed similar level to each other of different fertilization plots at mid-season but was higher in organic fertilizer plots at the post-harvest. Nitrogen in nitrate status showed nearly similar behavior where combination of compost and chemical fertilizer (T3) was higher at the post-harvest. Generally, the nutrient effect of organic fertilizers depends largely on the transformation

processes that take place in the soil after their application. The products of soil mineralization and nitrification are NH_4^+ and NO_3^- which comprise the majority of N available for crops (34). Nitrification is the process where ammonium ions in the soil are enzymatically oxidized to nitrates (5).

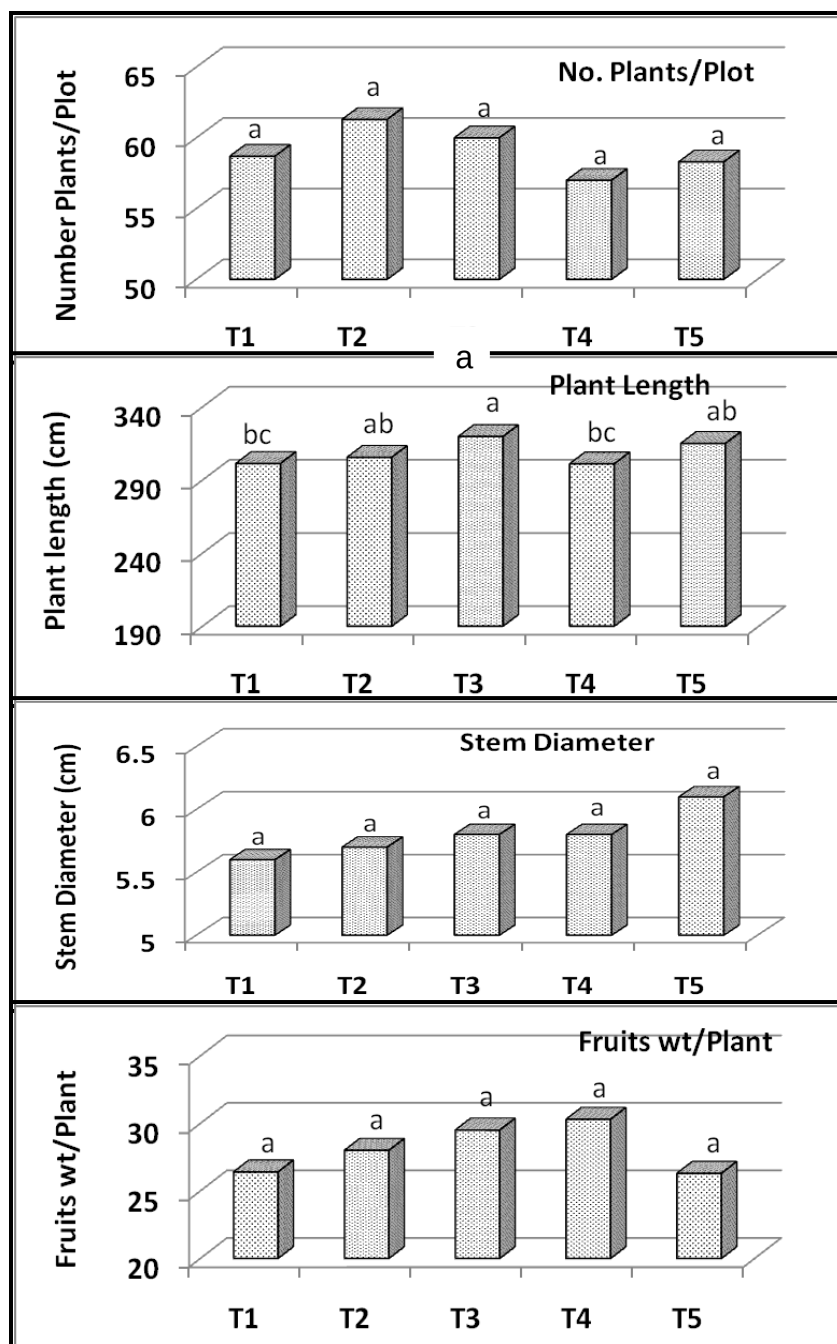


Fig. 1: Number of plants per plot, plant length and stem diameter at the end of season, and average fruit weight per plant.

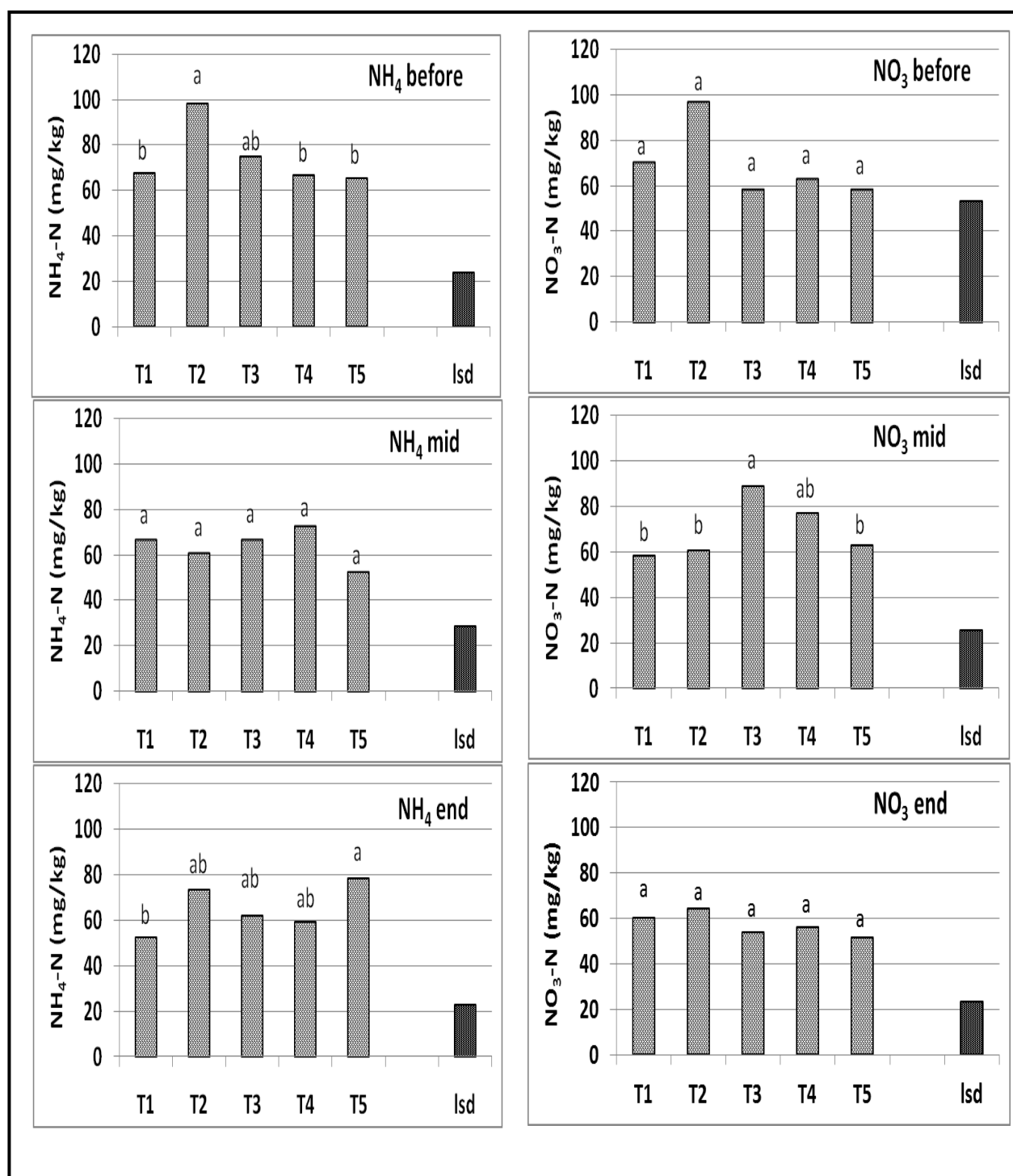


Fig. 2: Soil NH_4 and NO_3 at planting (before), during season (mid), and post- harvest (end) for the treatments of chemical fertilization, compost, and vermicompost.

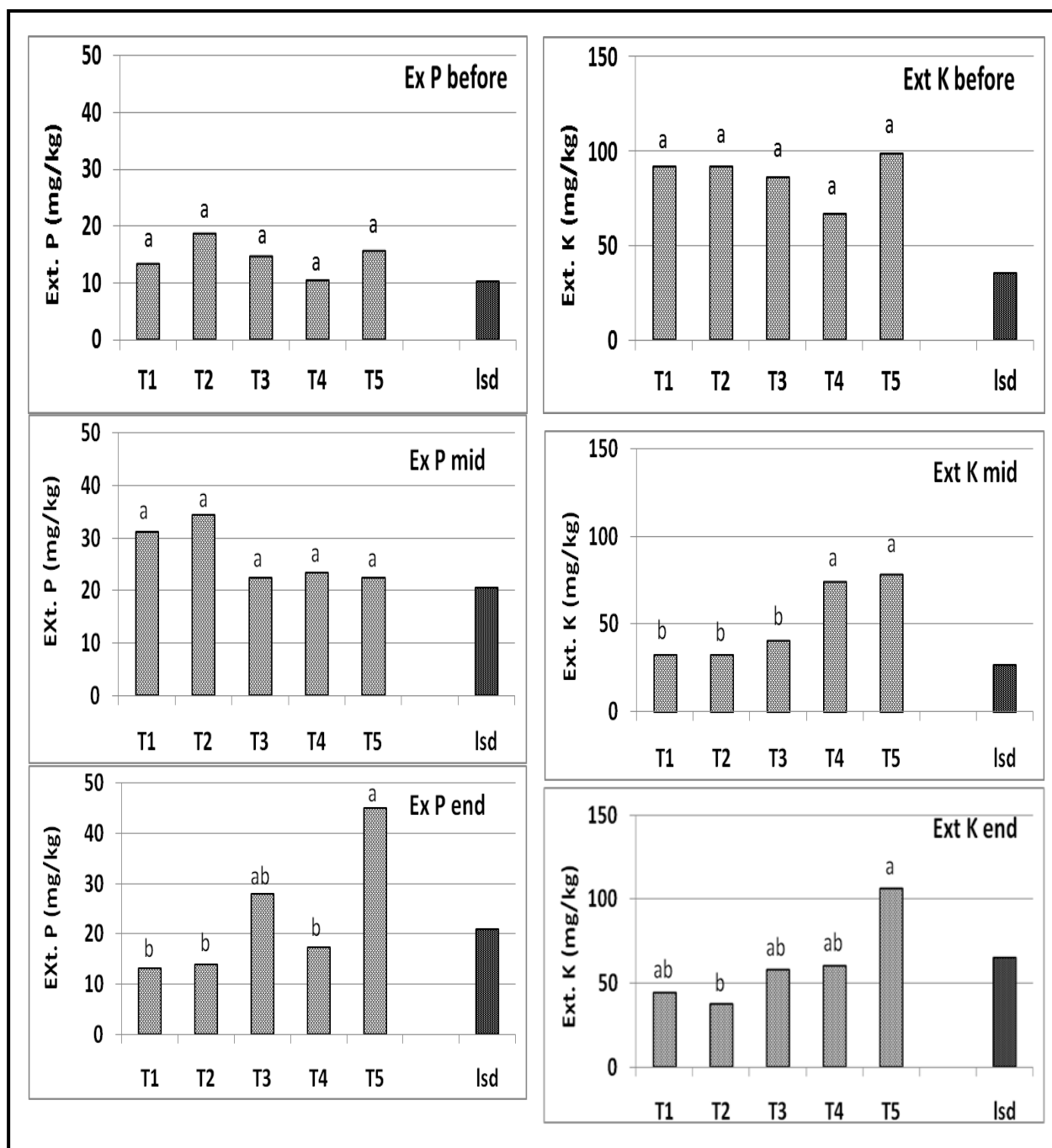


Fig. 3: Soil P and K at planting (before), during season (mid), and post-harvest (end) for the treatments of chemical fertilization, compost, and vermicompost.

Available phosphorus (NaHCO_3 Extractable) for the five treatments for three time periods (before planting, mid-season, and post-harvest) is presented in Figure (3). In general, no significant differences were found among the available P before planting. The differences were slight in the range 10.5-18.6 mg/kg. However, the magnitudes of available P were increased during the mid-season (Ext. P mid) and reached the range 22.5-34.5 mg/kg. The use of compost and vermicompost individually or in combination of compost and chemical fertilizer

enhanced the release of appreciable amounts of available P. In spite that the amount of nutrients in compost or vermicompost varies depending on the material from where they are originated, both of them constitute a slow release source of nutrients that supply the plants with the nutrients (25).

Different behavior was observed for soil available P at the end of season where Extractable P was the highest and different significantly for T5 (vermicompost) followed by T3 (vermicompost+chemical fertilizer) (Figure 3). Several examples in the literature show that compost and vermicompost are able to supply of nutrients (14, 16), mycorrhizal colonization (7), microbial activity (12) and suppressiveness of soil borne plant pathogens (26).

Generally, replacement of chemical fertilizer with different amounts of compost or vermicompost produces appreciable amounts of extractable K at the mid-season and end season (Figure 3). Both the use of 30 ton compost/ha (T4) and 2.5 ton vermicompost/ha resulted in the highest Ext. K at mid-season and significant different from the other treatments. Nearly similar trend was observed for Ext. K at the end season where the highest values exhibited by the compost and vermicompost. These data indicates that the use of compost alone or vermicompost maintained the levels of Ext. K at the mid-season and end season and performed the best. This can be attributed to the high nutrient sustainability of organic fertilizer and the improved biological properties of the soil.

The electrical conductivity of the soil at planting, during season, and at the end of season indicated no significant differences among treatments (data not presented). However, the magnitudes of EC were reduced with progress of season. The highest was in the range 3.1-5.1 dS/m observed before planting and the lowest was in the range 1.0-2.0 dS/m observed at the end of season. This result stems from the fact that the irrigation practices during season had reduced salinity due to leaching of soluble salts.

Conclusions:

- 1- Application of organic fertilizers (compost or vermicompost) or a combination of compost and chemical fertilizer performed comparable effect on tomato yield as the full dose of chemical fertilizer.
- 2- By organic fertilization, concentration of macronutrients in soil (NH_4 , NO_3 , Ext P, and Ext K) remained high even at post-harvest indicating the beneficial effect of organic fertilization in supplying nutrients.
- 3- There is a need for further investigations to establish the role of organic fertilization in replacing the chemical fertilization and in improving soil productivity. Accordingly, long term compost fertilization has to be considered in the framework of organic farming system.

REFERENCES

- 1- Akanbi, W. B. and A. O. Togun (2002). The influence of maize- stover compost and nitrogen fertilizer on growth, yield and nutrient uptake of Amaranth. *Sciatica Horticulturae*, 93:1-8.
- 2- Alshook, R.H.J. (2001). Evaluation of hybrid cultivars performance under plastic house conditions. *Iraqi J. Agric.*, 6(2):125-131.
- 3- Bachman, G.R. and J.D. Metzger (2007). Physical and chemical characteristics of a commercial potting substrate amended with vermicompost produced from two different manure sources. *Hort. Technology*, 17:336-340.
- 4- Black, C.A., et al. (ed.) (1967). *Methods of Soil Analysis, Part 1. Agronomy* 9, Am. Soc. Agronomy Inc., Madison, Wisconsin.

- 5- Brady, N.C. and R.R. Weil (2008). The nature and properties of soils. 14th ed. Pearson Education, Inc. Upper Saddle River, NJ.
- 6- Brandt, K and J.P. Molgaard (2001). Organic agriculture: Does it enhance or reduce the nutritional value of plant foods? *J. Sci. Food Agric.*, 81: 924-931.
- 7- Cavender, N.D.; R.M. Atiyeh; and M. Knee (2003). Vermicompost stimulates mycorrhizal colonization of roots of *Sorghum bicolor* at the expense of plant growth. *Pedobiologia*, 47: 85-90.
- 8- Chaoui, H.I.; L.M. Zibilske and T. Ohno (2003). Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. *Soil Biol. Biochem.*, 35: 295-302.
- 9- Cotxarrera L.; M.I. Trillas-Gay; C. Steinberg and C. Alabouvette (2002). Use of sewage sludge compost and *Trichoderma asperellum* isolates to suppress *Fusarium* wilt of tomato. *Soil Biology and Biochemistry*, 34: 467-476.
- 10- Courtney, R.G. and G.L. Mullen (2008). Soil quality and barley growth as influenced by the land application of two compost types. *Bioresource Technology*, 99:2913-2918.
- 11- Daoud, M.S.; H.A. Al-Aziz and Z.A. Stephan (2001). Evaluation of some hybrid varieties in central region of Iraq. *Iraqi J. Agric.*, 6(2):117-124.
- 12- Domínguez, J. (2004). State-of-the-art and new perspectives on vermicomposting research. *In: Earthworm Ecology* (Edwards C.A., ed). CRC Press, Boca Raton., p: 401-425.
- 13- Ebertseder, T. and R. Guster (2003). Effect of long-term compost application on physical properties of loamy soils. *In: L. Zahrer and D. G. Lawrence, Applying Compost Benefits and Need, Seminar Proceedings, European Communities*, p: 229-233. <http://europa.eu.int>.
- 14- Edwards, C.A.; J. Dominguez and N.Q. Arancon (2004). The influence of vermicompost on plant growth and pest incidence. *In: Soil Zoology for Sustainable Development in the 21st Century*, Shakir S.H., Mikhail W.Z.A., eds. Cairo, p: 396-419.
- 15- Eghball, B. (2000). Nitrogen mineralization from field applied beef cattle feedlot manure or compost. *Soil Science Society of America Journal*, 64:2024-2030.
- 16- Grigatti, M.; M.E. Giorgonni and C. Ciavatta (2007). Compost-based growing media: influence on growth and nutrient use of bedding plants. *Bioresource Technol.* 98:3526-3534.
- 17- Huang, J.; C. Wang and C. Jih (2000). Empirical model and kinetic behavior of thermophilic composting of vegetable waste. *J. Environ. Engineering* 126:1019-1025.
- 18- Jacobsen, S.T. (1995). Aerobic decomposition of organic wastes. 2: Value of compost as a fertilizer. *Resour. Conservation Recycle* 13:57-71.
- 19- Joshua, W. D.; D.L. Michalk; I.H. Curtis; M. Salt and G.J. Osborne (1998). The potential for contamination of soil and surface waters from sewage sludge (biosolids) in a sheep grazing study. *Australia Geoderma*, 84:135-156.
- 20- Keener, H.M.; D.L. Elwell; K. Ekinici and H.A.J. Hoitink (2001). Composting and value-added utilization of manure from a swine finishing facility. *Compost Sci. and Utilization*, 9:312-321.
- 21- Lazcano, C; J. Arnold; A. Tato; J. G. Zaller and J. Domínguez (2009). Compost and vermicompost as nursery pot components: effects on tomato plant growth and morphology. *Spanish J. Agric. Res.*, 7:944-951.
- 22- LSU Ag Center (Louisiana State University Agricultural Center). (1996). *Basic Principles of Composting*. Pub. 2622.
- 23- Maynard, A.A. and D.E. Hill (2000). Cumulative effect of leaf compost on yield and size distribution in onions. *Compost Sci. and Utilization* 8:12-18.
- 24- Meherunnessa, N.; M. Talukder and H.M. Zakir (2011). Influence of compost and fertilizers on growth, yield and some biochemical composition of summer tomato. *Bangladesh Res. Pub. J.*, 5:344-350.

- 25- Nevens, F. and D. Reheul (2003). The application of vegetable, fruit and garden waste (VFG) compost in addition to cattle slurry in a silage maize monoculture: nitrogen availability and use. *Euro. J. Agron.*, 19:189-203.
- 26- Noble, R. and E. Coventry (2005). Suppression of soil borne plant diseases with composts: a review. *Biocontrol Sci. Technol.*, 15:3-20.
- 27- Nortcliff S. and F. Amilinger (2003). N and C pools-what is their fate in compost amended systems? *In: L. Zahrer and D. G. Lawrence, Applying Compost Benefits and Need, Seminar Proceedings, European Communities*, p: 19-36. <http://europa.eu.int>
- 28- Ozores-Hampton, M.; T.A. Obreza and G. Hochmuth (1998). Using composted wastes on Florida vegetable crops. *Hort. Technology.*, 8 (2):130-137.
- 29- Parkinson, R.J.; M.P. Fuller and A.C. Groenhof (1999). An evaluation of greenwaste compost for the production of forage maize (*Zea mays* L.), *Compost Sci. and Utilization*, 7(1):71-80.
- 30- Patil, M.B.; R.G. Mohammed and P.M. Ghadge (2004). Effect of organic and inorganic fertilizers on growth, yield and quality of tomato. *J. Maharashtra Agricultural University*, 29(2):124-127.
- 31- Sanchez, J.E.; T.C. Willson; K. Kizilkaya; E. Parker and R.R. Harwood (2001). Enhancing the mineralizable nitrogen pool through substrate diversity in long term cropping systems. *Soil Science Society of America Journal*, 65:1442-1447.
- 32- Segarra1, G.; M. Reis; E. Casanova1 and M.I. Trillas (2009). Control of powdery mildew (*Erysiphe Polygon*) in tomato by foliar applications of compost tea. *J. Plant Pathology*, 91 (3):683-689.
- 33- Shi, W.; B.E. Miller; J.M. Stark and J.M. Norton (2004). Microbial nitrogen transformations in response to treated dairy waste in agricultural soils. *Soil Science Society of America Journal*, 68:1867-1874.
- 34- Stockdale, E.A.; N.H. Lampkin; M. Hovi; R. Keatinge; E.K.M. Lennartsson; D.W. MacDonald; S. Padel; F.H. Tattersall; M.S. Wolfe and C.A. Watson (2001). Agronomic and environmental implications of organic farming systems. *Advances in Agronomy*, 70: 261-327.
- 35- Stofella, P.J. and D.A. Graetz (2000). Utilization of sugarcane compost as a soil amendment in a tomato production system. *Compost Science and Utilization*, 8 (3):210-214.
- 36- Togun, A.O.; W.B. Akanbi and J.A. Adediran (2004). Growth, nutrient uptake and yield of tomato in response to different plant residue composts. *WFL Publisher Science and Technology. Food Agric. and Environ*, 2 (1):310-316. www.world-food.net
- 37- Togun, A. O.; W.B. Akanbi and R. Dris (2003). Influence of compost and nitrogen fertilizer on growth, nutrient uptake and fruit yield of tomato (*Lycopersicon esculentum*). *Crop Research*, 26(1): 98-105.
- 38- Vetterlein D. and R.F. Hüttnl (1999). Can applied organic matter fulfill similar functions as soil organic matter? Risk-benefit analysis for organic matter application as a potential strategy for rehabilitation of disturbed ecosystems. *Plant Soil*, 213: 43-54.
- 39- Woese, K.; D. Lange; C. Boess and K.W. Bogl (1997). A comparison of organically and conventionally grown foods - Results of a review of the relevant literature. *J. Sci. Food Agric.*, 74: 281-293.

تقييم تغيير التسميد العضوي للطماطة المزروعة في بيت بلاستيكي

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الملخص

التسميد العضوي هو ممارسة مهمة في الزراعة العضوية. تهدف هذه الدراسة لتقويم أداء السماد العضوي الكومبوست والفيرميكومبوست في تحسين إنتاجية الأراضي وحاصل الطماطة (صنف ساندرا). أجريت تجربة في بيت بلاستيكي للموسم 2010-2011 في موقع تحضير الأسمدة العضوية في محافظة واسط، المركز الوطني للزراعة العضوية، وزارة الزراعة. تم تقسيم البيت البلاستيكي إلى ثلاثة قطاعات. ووزعت خمس معاملات عشوائياً على كل قطاع، T1: الأسمدة الكيميائية الموصى بها، T2: 10 طن كومبوست/هكتار + 1/2 التوصية السمادية، T3: 20 طن كومبوست/هكتار + 1/4 التوصية السمادية، T4: 30 طن كومبوست/هكتار، و T5: 2.5 طن فيرميكومبوست/هكتار. خلط السماد العضوي أو السماد العضوي+الأسمدة الكيميائية، أو الفيرميكومبوست مع الطبقة السطحية من التربة 0-20 سم. وضع تصميم القطاعات كاملة التعشية في ثلاث مكررات. تم تزويد البيت البلاستيكي بنظام الري بالتنقيط. جرت مكافحة الآفات باستخدام المواد المسموح بها وفقاً لقواعد الزراعة العضوية. أشارت النتائج إلى أنه لا توجد فروق ذات دلالة معنوية بين متوسطات الحاصل مع ملاحظة أعلى حاصل في اللوح ذي المساحة 9 م² (186.3 كغم) للمعاملة T3 والأدنى 162.7 كغم للمعاملة T5. عموماً، إن استبدال الأسمدة الكيميائية بمعدلات مختلفة من الكومبوست أو الفيرميكومبوست أنتجت آثاراً مفيدة على عوامل ونمو النبات. بقيت مستويات الأمونيوم (52.5-73.6 ملغم/كغم) والنترات (45.5-88.8 ملغم/كغم) عالية أثناء منتصف الموسم وبعد الحصاد. إن مقادير P المستخلص خلال منتصف الموسم وصلت إلى مدى 225-34.5 ملغم/كغم. وقد لوحظ سلوك مختلف في نهاية الموسم. إذ كان P أعلى عند T5 تليها T3. أدى استخدام 30 طن كومبوست/هكتار (T4) و 2.5 طن فيرميكومبوست/هكتار (T5) إلى أعلى K في منتصف الموسم واختلفت كثيراً عن غيرها من المعاملات. ولوحظ اتجاه مماثل تقريباً لقيم K في نهاية الموسم حيث أظهرت أعلى القيم للكومبوست والفيرميكومبوست. تشير هذه النتائج أن التسميد العضوي حافظ على مستويات عالية من المغذيات الكبرى أثناء موسم النمو وبعد الحصاد.