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TOMATO RESPONSE TO COMPOST AMENDMENTS AND LIQUID ORGANIC FERTILIZER APPLIED THROUGH FOLIAR AND DRIP FERTIGATION

A. A. F. Al-Taii Sh. S. Ibrahim H. A. Hadwan
S. S. Shahadha M. Ali Kathum M. F. Abdul Hameed

ABSTRACT

The main aim of the study is to investigate the response of tomato to practice of organic farming through application of compost to improve soil environment and liquid organic fertilizer as a source of nutrients. Multi-span plastic house (36x27.6m) located at the Experimental Farm of the Extension Department, Ministry of Agriculture, Kut, Wasit Governorate- Iraq, was used to grow tomato for the season 2012/2013. The main plots were the application of compost in 20 and 40 $Ton.ha^{-1}$ and the subplots were the application of organic liquid fertilizer (OLF) through either drip fertigation or foliar. The treatments arranged in the field according to Randomized Complet Block Desigh (RCBD) in three replicates. The Compost had been produced at the site of composting, Ministry of Agriculture, Kut, Iraq and the organic liquid fertilizer at the Integrated Management of Plant Production and Protection, Ministry of Agriculture, Baghdad, Iraq. Results indicated that both the 20 and 40 m $ton.ha^{-1}$ compost were sufficient in improving soil characteristics and enhancing plant growth. The two methods of supplying nutrients to crop (fertigation or foliar application) were very close in effect on tomato yield. Although the foliar application was associated with the use of low N dose OLF, it produced comparable yield to that produced by the fertigation associated with the use of high N dose OLF. Analysis of total available N, P, and K in soil as well as the mineral forms of N (NH_4 and NO_3) indicated no significant differences found among the treatments during the growing season at mid-season and post-harvest. It can be concluded that the 20 $ton.ha^{-1}$ compost/ha was sufficient to supply N, P, and K for plant growth and development and to maintain appreciable concentrations through the growing season. Soil organic matter had been increased during the growing season. Therefore, it is evident that the application of compost supplemented by organic liquid fertilizer was successful practice to meet crop demand for nutrients and maximize crop yield.

INTRODUCTION

Organic farming in its simple term is a production system that excludes synthetic inputs when possible and uses external inputs only when the system cannot be sustained by internal recycling (33). This production method avoids or largely reduces the use of synthetic chemical inputs, such as chemical fertilizers and pesticides, and aims to minimize negative effects on the environment and maintains the biological diversity of the soil (14,27). Organic farming systems Rely on the management of soil organic matter to enhance the chemical, biological, and physical properties of the soil, in order to optimize crop production (31).

The organic fertilizers could be produced from both urban and agricultural wastes and its production is increasing worldwide through composting technology (29). Many investigators have indicated the beneficial

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effects of compost application on land productivity and the control of pathogens.

These include the improvement in soil properties (8), increase in yield and improve quality (17, 24, 30), and the reduction of weed germination and number of plant pathogens (6, 20, 25).

There is a growing interest in foliar fertilization as a method for feeding nutrients to plant upper parts or to control diseases and pathogens. Foliar fertilization is an agricultural practice helping to reduce the environmental impact associated with soil fertilization (10). It has several main advantages over other methods of soil fertilization include avoiding the occurrence of soil interactions that may limit root uptake (11). Combined soil and foliar applications may be recommended to increase both plant productivity and yield quality (15). However, the foliar fertilization is becoming more prevalent as practice in agricultural crop production, because it is more purposefully and potentially more friendly to the environment in contrast to soil fertilization. In terms of nutrient absorption, foliar fertilization can be from 8 to 20 times as efficient as ground application (12). While foliar fertilization is being used on a wide variety of crops, its economic value is generally deemed greater for horticultural than for field crops. This is because horticultural crops are of higher value and their nutrient status is more carefully monitored (12).

Drip irrigation systems are widely used in Iraq and are continually expanding. These irrigation systems proved to increase the water use efficiency and therefore decrease the losses of water by evaporation and leaching as observed with traditional irrigation systems (18). Also, these systems are ideally suited for controlling the placement and supply rate of water-soluble fertilizers in fertigation technology. Nutrients can be injected at various frequencies (daily to monthly), depending on system design constraints, soil type and grower preference (4). Drip irrigation and fertigation with N fertilizer sources offer what is probably the ultimate in flexibility for N fertilizer management. If properly managed, fertigation through drip irrigation lines can reduce overall fertilizer application rates and minimize adverse environmental impact of vegetable production (22, 28).

Considering the above facts, the present research work was undertaken to (i) examine the importance of organic fertilization (application of compost and organic liquid fertilization) in Iraq vegetable production, (ii) study the role of organic fertilization in tomato production, and (iii) compare the effect of foliar application and drip fertigation on tomato yield and nutrients balance in soil.

Materials and Methods

The investigation was carried out at the Experimental Farm of the Extension Department, Ministry of Agriculture at Kut, Wasit Governorate, 200 km south of Baghdad, Iraq for the season 2012/2013. The soil texture of the upper 0-50 cm is Sandy Loam. Some soil characteristics (ECe, pH, NH_4, NO_3, available P, and K, and Organic Matter %) are given in Table (1).

Preperation of Compost and Liquid Organic Fertilizer

The compost used in the study was produced at the “Composting Site, Wasit, National Center for Organic Framing, Ministry of Agriculture”. Production of compost was based on biological decomposition of wheat straw. The main steps in production of the compost can be found elsewhere (1). Detailed characteristics of the compost are given in Table (2).

Table 1: Some soil characteristics of the site

Soil Characteristics	mean	max	min	st dev
EC_e ($dS\ m^{-1}$)	4.3	10.7	1.6	2.6
pH	8.3	8.6	8.1	0.1
NH_4-N (mg kg^{-1})	62.3	91.1	42	16.7
NO_3-N (mg kg^{-1})	71.5	91.1	49	14.3
Ext P (mg kg^{-1})	305.8	400	7.7	98.6
Ext K (mg kg^{-1})	91.8	148	54	30.3
OM%	0.81	2.35	0.07	0.7

Table 2: Some chemical and physical characteristics of the compost and the composition of the organic liquid fertilizer (Types A and B)

No.	Character	Compost	Liquid Organic Fertilizer	
			Type A	Type B
1	EC ($dS\ m^{-1}$)	3.5	34.2	34.2
2	pH	7.2	7.73	7.72
3	C (%)	50	n.m.	n.m.
4	Total-N (%)	2 .1	0.28	3.2
5	C/N	23.8	---	---
6	P (%)	0.65	0.28	0.28
7	K (%)	1.8	0.088	0.088
8	Ca (%)	2.3	10.02	10.02
9	Mg (%)	0.75	7.29	7.29
10	Fe (mg L^{-1})	n.m.	81.30	81.34
11	Cu (mg L^{-1})	n.m.	n.m.	n.m.
12	Zn (mg L^{-1})	n.m.	40.80	40.82
13	Mn (mg L^{-1})	n.m.	34.16	34.16
14	Water content (%)	35	---	---
15	Bulk Density (g cm^{-3})	0.650	---	---
16	Porosity (%)	40	---	---

n.m. = not measured

The organic liquid fertilizer used for either foliar application or drip fertigation has been produced from mature compost. The method is based on extraction of nutrients, humic acids, and other biological compounds from compost under aerobic conditions. Ten kg compost is enclosed by piece of fabric and placed in the middle part of 40-Litter container filled with water. To maintain aerobic conditions, air is pumped continuously into the system during the process of extraction. A mixer is used periodically to minimize the settlement of large organic pieces. At the end of 10 days, the liquid is ready to use as organic liquid fertilizer, Type A. To increase the content of N in the basic liquid fertilizer, the fertilizer was enriched by urea to form “Type B” organic liquid fertilizer. Chemical composition of both Type A and Type B fertilizers is given in Table (2).

Experiment Layout, Application of Organic Fertilizers, and Treatments

The experiment was carried out in multi-span plastic house (36m x 27.7m). The main plot was the application of compost in two rates, 20 Mg (ton.ha$^{-1)}$ and 40 Mg (ton.ha^{-1}) mixed with the upper 20 cm of the soil. The sub treatment was the application of organic liquid fertilizer through drip irrigation system (0.5 L of Type B, two times a week) or foliar application (2 L of Type A in 100 L water, two times a week). Each treatment (experimental unit) (24 m^2) was conducted in four plots of 6.0 m^2 (10m x 0.6 m) and assigned randomly. Each sub plots was assigned randomly to half of the plastic house. The experiment design was a Randomized Complet Block Desigh (RCBD) in three replicates. Sufficient space was separated the plots, the blocks, and the sub plots.

The plastic house was equipped with drip irrigation system to supply irrigation water. A by-pass fertigation system was connected to the drip system to supply liquid organic fertilizer (Type B) to half of the plastic house. The source of irrigation water is the Tigris river with EC = 1.2 $dS.m^{-1}$.

Agricultural Practices and Soil Sampling During Season

Tomato (*Lycopersicon esculentum*) seedlings, variety "Nora" were transplanted to the plastic house on 15-10-2012 in two rows in each plot. The distance between plants was 60 cm and between rows was 40 cm.
Control of pest was carried out before planting and during plant development using biological methods. The "bio-insecticide Trichoderma" was applied to the plastic house with the application of compost in 350 g in 100 L to control fungus diseases. The same insecticide was used two more times during the growing season in concentration of 35 g/20 L to control aerial fungi and another two applications of 125 g/50 L water to control aerial fungi and early blight. Oxymetrin (4 mL/10 L) was used for two times to control the leaves borers. The biological agent (BT) (300 g/100 L water) was used for two times to control insects, white fly, and *Tota absoluta*.

Soil samples were taken from 0-20 cm and 20-50 cm soil depths over each plot at planting, mid-season, and post-harvest. The samples were air-dried for analysis using the general procedures described by Black *etal*. (5). 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 was determined using KCl as the extracting solution and determined by steam distillation. Organic matter was determined by Walkley-Black dichromate digestion method. Micro nutrients in organic liquid fertilizer (Mn, Cu, Zn, and Fe) were determined using Atomic Absorption.
Harvest of tomatoes fruits was started on 15-3-2012 and continued to 20-5-2013. Yield was recorded for the experimental unit of four plots (24 m^2) covered 124 plants.

RESULTS AND DISCUSSION

Yield of Tomatoes

The analysis of variance for yield of tomato revealed no significant differences among the four treatments (Fig. 1). Also, pooling of data over either the main treatments (20 and 40 ton compost/ha) or the sub treatments (applying organic liquid fertilizer through fertigation or foliar application) resulted in non-significant differences in yield of tomatoes. Therefore, it is evident that both 20 and 40 $Ton.ha^{-1}$ compost was sufficient in improving soil characteristics and enhancing plant growth. In the same line, many researchers have assessed the positive effects of compost on soil environment (eg., 3, 25) and successfully increase yield of tomato (29).

It seems that both methods of supplying nutrients to crop (fertigation or foliar application) were very close in their effect on tomatoes yield (Fig. 1). Even though the foliar application was associated with the use of low N dose organic liquid fertilizer, Type A (Table 2), it produced comparable yield to that produced by the fertigation associated with the use of high N dose, Type B organic liquid fertilizer. In this respect, Kuepper (12) indicated that foliar fertilization can be more efficient than ground application. Also, there are numerous processes taking place within soils and nutrients applied to the soil are complexes by a

number of reactions such as mineralization, leaching and organic complex formation, which result in a decrease in their plant-available fractions (19).

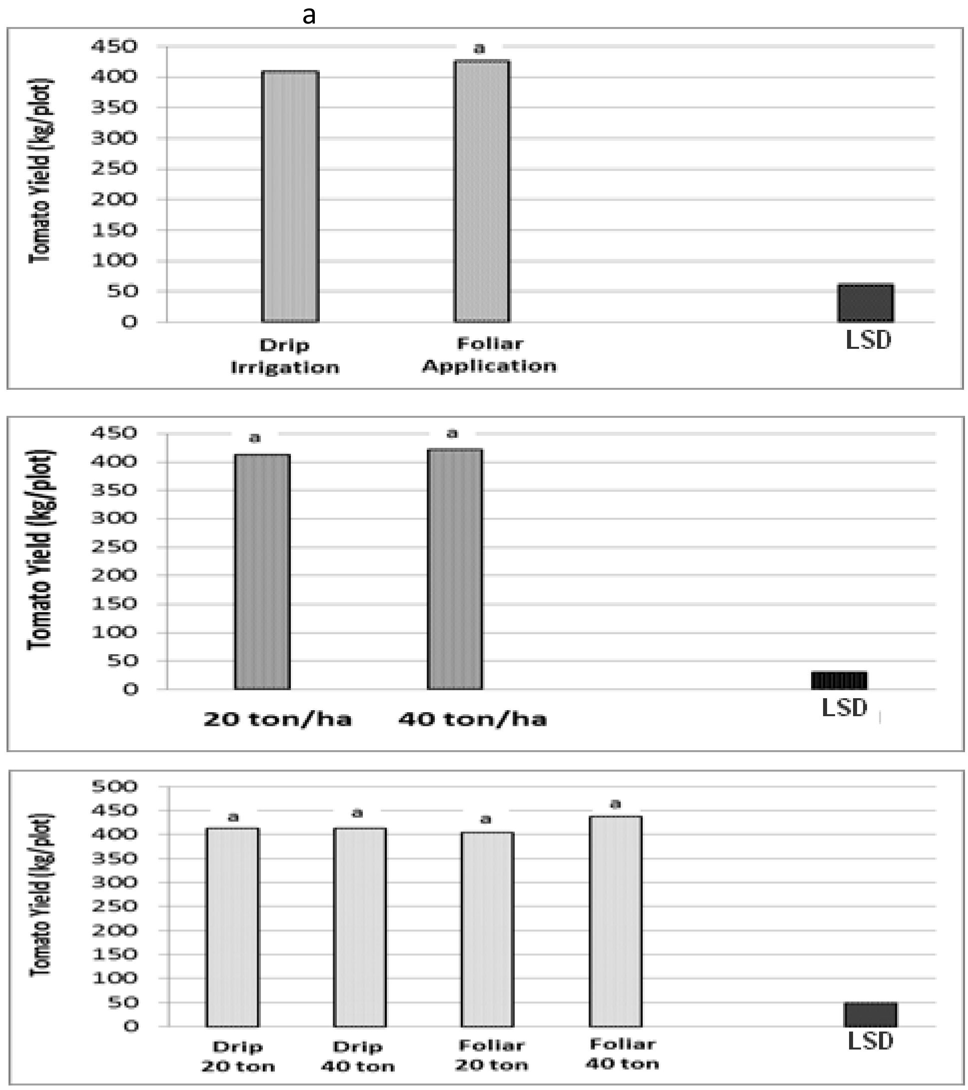

Fig. 1: Yield of tomato in response to application of liquid Organic fertilizer either through the drip system or foliar and the application of compost in 20 or 40 ton.ha^{-1}.

Macro Nutrients and Organic Matter Status in Soil

Table (3) illustrates the effect of compost and organic liquid fertilizer application on mineral N forms (NH_4 and NO_3) at planting, midseason, and post-harvest. Based on LSD test, significant differences were found only at planting for the form NH_4^+-N. On the other hand, no significant differences were found for both NH_4 and NO_3 among treatments at midseason or post-harvest. The reason behind the differences found at planting is the past history of agricultural practices including fertilization (The plastic house received varied rate of compost application in the last year). However, these differences were minimized and disappeared with the application of compost and continuous application of organic liquid fertilization through fertigation and leaf feeding. It is evident that neither the different rate of compost application nor the different method and concentration of organic liquid fertilizer imposed differences in mineral N-forms during plant development. However, the low rate of compost application 20 m ton. ha^{-1} was adequate for the formation of NH_4-N and NO_3^- -N during the season. This result is confirmed by the finding of Lazcano (13) who indicated that the NH_4^+-N and NO_3-N of mature compost can be considered as almost completely plant available in the year of application. In the same line, Eghball (9) found that 12% of compost N can be mineralized in the first year of compost application.

Percent of organic matter (OM) in soil at planting, midseason, and post-harvest is presented in Table 3. Similar trend of NH_4^+-N was observed for the OM behavior where the significant differences were found only at planting. At the same time it is noted that the magnitudes of OM content were increased with the proceeding of the growing season. This was evident for all treatments where the increase was in the range 14 to 160% at the end of season. In the same line, McConnell et al. (16) reported that compost applied at rates varying from 18 to 146 ton/ha produced a 6 to 163% increase in soil organic matter. Increases of soil organic matter as a result of compost application has been reported by many authors (e.g., 23, 35). A study by Zebarth et al. (34) over a three-year period showed increases in soil organic matter from five different organic sources including biosolids, food waste and composted pig manure

Macro nutrients status in soil (N, P, and K) at planting, midseason, and post-harvest is presented in Figures 2, 3, and 4, respectively. It is clear that no significant differences were found among the four treatments. However, the magnitudes of elements were varied depending on specific element and the time in the season. In general, levels of elements for all treatments remained in amounts during the season.

Table 3: The effect of liquid organic fertilizer applied either (fertigation) or as foliar application in plastic house. (DR: drip irrigation, FA: foliar application, and 20 and 40 are m tons compost.ha^{-1}).

Concentration of NH_4 or NO_3 and Soil Organic Matter					
At Planting		Mid-Season		Post-Harvest	
NH_4-N (mg/kg)					
FA40	78.3 a[+]	DR20	72.4 a	DR40	73.6 a
FA20	67.7 ab	FA20	67.7 a	DR20	68.9 a
DR40	65.4 ab	DR40	65.4 a	FA40	65.4 a
DR20	53.7 b	FA40	65.4 a	FA20	63.0 a
LSD	15.58	LSD	18.5	LSD	14.98
NO_3-N (mg/kg)					
FA20	82.9 a	DR20	74.8 a	DR20	79.4 a
DR40	73.6 a	DR40	73.6 a	FA20	74.8 a
FA40	65.4 a	FA20	73.6 a	DR40	71.2 a
DR20	63.0 a	FA40	61.9 a	FA40	66.6 a
LSD	20.87	LSD	17.96	LSD	16.64
OM%					
DR20	1.063 a	FA40	1.12 a	DR20	1.21 a
FA40	0.547 ab	FA20	0.92 a	FA20	1.11 a
FA20	0.543 ab	DR20	0.61 a	FA40	1.08 a
DR40	0.357 b	DR40	0.54 a	DR40	0.95 a
LSD	0.676	LSD	0.85	LSD	0.29

+ Means within columns followed by the same letter are not significantly different at the 5% level of significance based on LSD test.

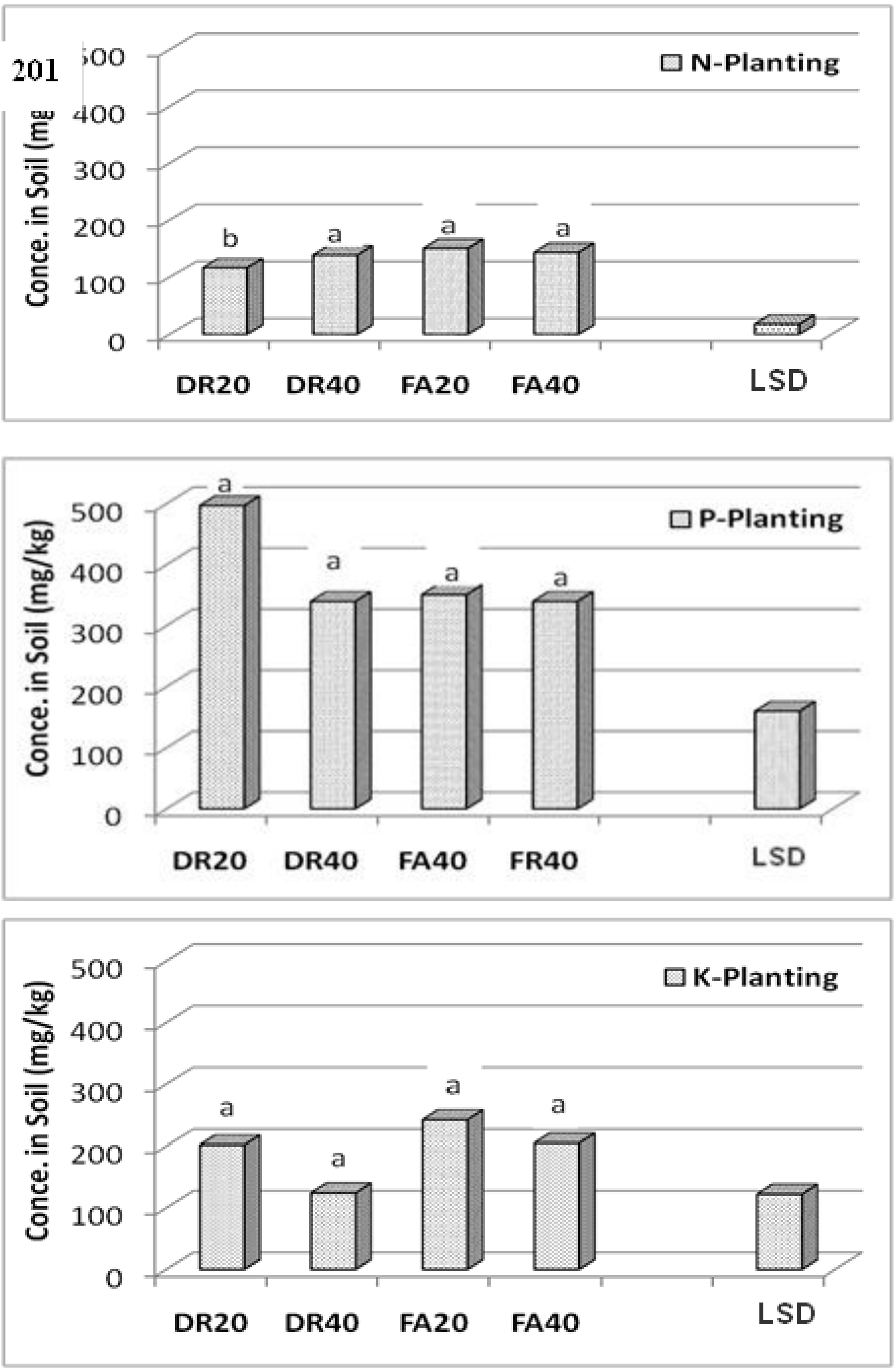

Fig. 2: Nutrients concentration in soil for the four treatments at planting. (DR: Drip irrigation, FA: Foliar application, and 20 and 40 are m tons compost.ha^{-1}).

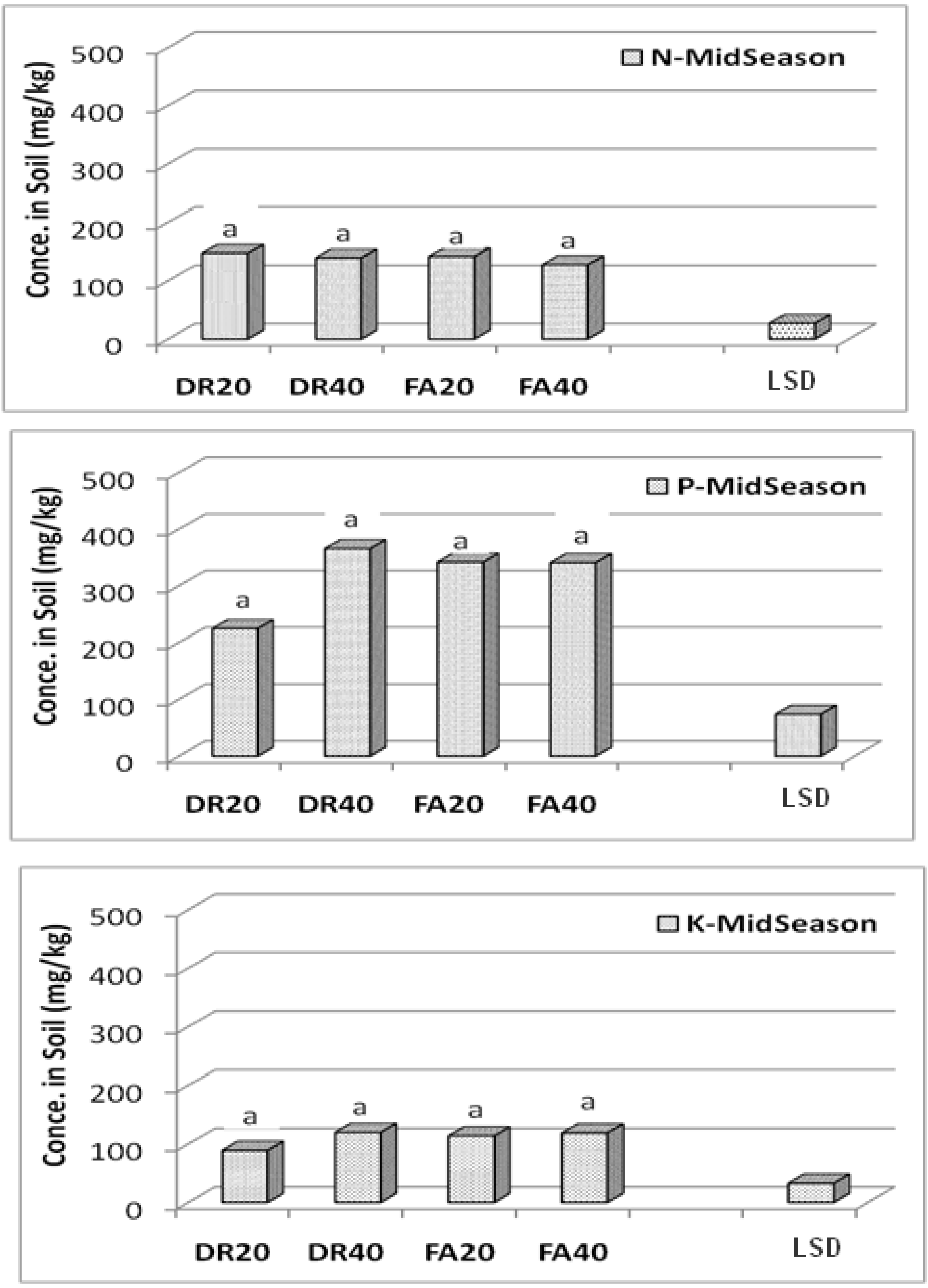

Fig. 3: Nutrients concentration in soil for the four treatments at midseason. (DR: Drip irrigation, FA: Foliar application, and 20 and 40 are m tons compost.ha^{-1}.

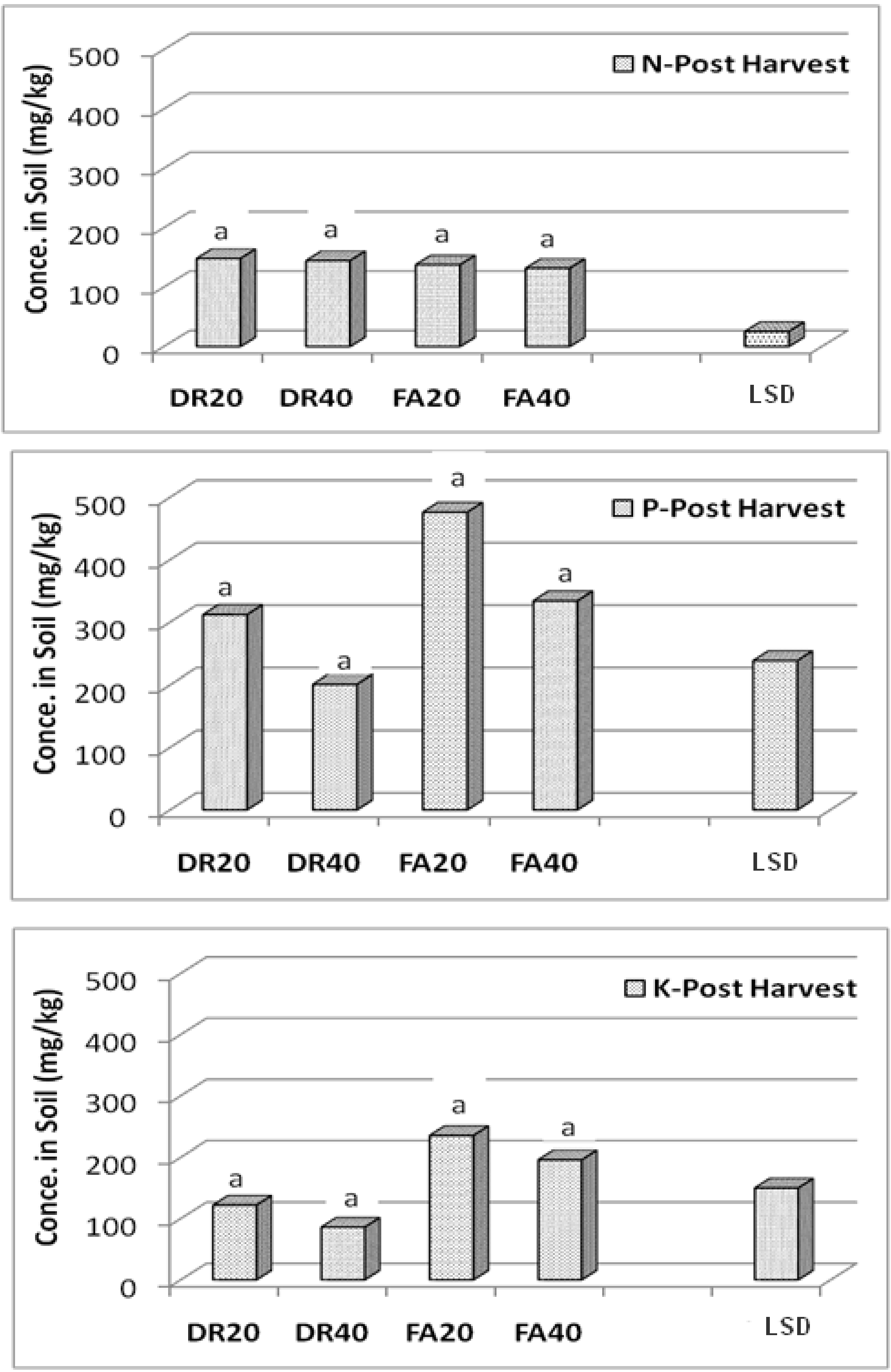

Fig. 4: Nutrients concentration in soil for the four treatments at post-harvest. (DR: Drip irrigation, FA: Foliar application, and 20 and 40 are m tons compost.ha^{-1}).

The season again the 20 m ton compost.ha^{-1} for the treatments FA20 (Foliar Application, 20 ton compost/ha) was sufficient to supply N, P, and K for plant growth and development. These results are in line of finding of Eghball (9) who indicated that compost provides soils nutrients that are beneficial to crops for many years. Furthermore, Nortcliff and Amlinger (21) stated that organic

additions to soil have long been considered important in maintaining the quality of both natural and managed soils, principally because of their role in providing nutrients and in influencing soil physical properties.

The range of macro nutrients was 117-151 for N, 340-497 for P, and 124-243 mg/kg for K at planting. These values changed with season to 127-147 for N, 225-366 for P, and 89 to 120 for K at mid-season and to 132-148 for N, 201-476 for P, and 86-235 mg/kg for K at post-harvest (Figs. 2-4). No trend can be drawn for the three nutrients with time, but in general there are adequate concentrations in soil to meet plant needs for growth and development. For N, 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 (26). In the present study, it is evident that the compost used is important nutrients carriers for N, P, K, and many other nutrients (Table 2). These results agree with many studies (e.g., 32) which showed that application of compost add substantial amounts of nutrients to soils which vary in a wide range depending on type of compost, raw material, and soil conditions. In this respect, Amlinger et al. (2) showed that after continued compost application, total and available phosphorus and potassium concentration respectively in the soil are increased. In contrast to nitrogen P, K and Mg show in principle higher plant availability.

Conclusions

1. **The application of compost and liquid organic fertilizer are important for vegetable crop management strategy toward organic farming. This practice proved successful to meet crop demands for nutrients and maximize crop yield.**
2. **Foliar feeding of nutrients was an effective tool and can replace soil fertilization through fertigation in producing of tomato.**
3. **Observed positive effects of compost have included maintain nutrients balance in soil during the growing season.**

REFERENCES

1- AlTaii, A. A.; S. S. Ibrahim; H. Ali; H. Muhamad; K. Ali and M. F. Abdul Hameed (2014). Comparative evaluation of organic fertilization of tomatoes cultivated in plastic house. J. Agric. Res. (Special Issue) 19(3):188-200.

2-Amlinger, F.; P. Dreher; S. Nortcliff and K. Weinfurtner (2001). Applying Compost: Benefits and Needs, Seminar Proceedings, Brussels, 22–23 November 2001, European Commission, pp.1-7.

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. HortTechnology,17:336-340.

4-Badr, M. A. and A. A. Abou El-Yazied (2007). Effect of fertigation frequency from subsurface drip irrigation on tomato yield grown on sandy soil. Australian J. of Basic and Applied Sci.,1(3):279-285.

5-Black, C.A.(ed.) (1967). Methods of Soil Analysis, Part 1. Agronomy 9, Am. Soc. Agronomy Inc., Madison, Wisconson.

6-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.
7-Curley, S. (ed.) (1994). Foliar nutrition. Midwest Laboratories Agronomist, Inc., Omaha, NE, USA.
8-Ebertseder, T. and R. Guster (2001).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, pp. 229-233. http://europa.eu.int.
9-Eghball, B. (2000). Nitrgoen mineralization from field applied beef cattle feedlot manure or compost. Soil Sci. Soc. of Am. J. 64:2024-2030.
10-Fernandez, V. and T. Eichert (2009). Uptake of hydrophilic solutes through plant leaves: current state of knowledge and perspectives of foliar fertilization, Critical Reviews in Plant Sci. 182:36-68.
11-Haytova, D. (2013). A Review of foliar fertilization of some vegetables crops. Annual Review & Research in Biology 3(4): 455-465.
12-Kuepper, G. (2003). Foliar fertilization. ATTRA- Project of National Sustainable Agriculture Information Service. Fayetteville, AR 72702, USA, http://www.attra.org/attra-pub/PDF/foliar.pdf.
13-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.
14-Mader, P.; A. Fliessbach; D. Dubois; L. Gunst; P. Fried and U. Niggli (2002). Soil fertility and biodiversity in organic farming. Science 296: 1694-1697.
15-McCall, W. (1980). Foliar application of foliar fertilizers, Hwaii Cooperative Extension Service, University of Hawaii, General hove garden series. 1980;24.
16-McConnell, D. B.; A. Shiralipour and W. H. Smith (1993). Compost application improves soil properties. Biocycle 34:61-63.
17-Meherunnessa, N.; M. Talukder and H. M. Zakir (2011). Influence of compost and fertilizers on growth, yield and some biochemical composition of summer tomato. Bangladish Res. Pub. J., 5(4):344-350.
18-Mohammad, M. J.; M. Al-Omary; S. Zuraiki and W. Qawasmi (2002). Nitrogen and Water Utilization by Trickle Fertigated Garlic Using the Neutron Gauge and N Technologies TECDOC-1266, IAEA, Vienna.
19-Njoloma, C. (2012). Application of foliar spray containing copper, zinc, and boron to mature clonal tea (Camellia sinensis): effect on yield and quality. M.Sc. thesis submitted to the faculty of Natural and Agricultual sciences, University of Pretoria.
20-Noble, R. and E. Coventry (2005). Suppression of soil borne plant diseases with composts: a review. Biocontrol Sci. Technol.,15:3-20.
21-Nortcliff, S. and F. Amlinger (2001). N and C pools – what is their fate in compost amended systems In: Applying Compost: Benefits and Needs, Seminar Proceedings, Brussels, 22–23 November 2001, European Commission, pp. 19-36.
22-Papadopoulos, I. (2000). Fertigation: Present Situation and Future Prospects. p. 3-55. In Proc. of the Intern. Fertigation Workshop “Plant Nutrient Management under Pressurized Irrigation Systems in the Mediterranean Region”. IMPHOS, Amman, Jordan, 25-27 April, 1999.

23-Parkinson, R. J.; M. P. Fuller and A. C. Groenhof (1999). An evaluation of green waste compost for the production of forage maize (Zea mays L.), Compost Sci. & Utilization,7(1):71-80.

24-Polat, E.; H. Demir; F. Erler (2010). Yield and quality criteria in organically and conventionally grown tomatoes in Turkey. Sci. Agric. Piracicaba, Braz. V(4):424-429.

25-Segarra, G.; M. Reis; E. Casanova and M. I. Trillas (2009). Control of powedery mildew (Erysiphe Polygon) in tomato by foliar applications of compost tea. J. of Plant Pathology (2009), 91(3):683-689.

26-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 J., 68:1867-1874.

27-Stockdale, E. A.; N. H. Lampkin; M. Hovi; R. Keatinge; E.K.M. Lennartsson,; D. W. MacDonald; S. Pade; 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.

28-Thompson, T. L.; T. A. Doerge and R. E. Godin (2002). Subsurface drip irrigation and fertigation of broccoli: I. Yield, quality, and nitrogen uptake. Soil Sci. Soc. Am. J., 66: 186-192.

29-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. Food, Agriculture & Environment, 2 (1):310-316.

30-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 Rese. 26(1):98-105.

31-Watson, C. A.; D. Atkinson; P. Gosling; L. R. Jackson and F. W. Rayns (2002). Managing soil fertility in organic farming systems. Soil Use & Management,18:239-247.

32-Weinfurtner, K. (2001). Plant nutrition and productivity: Is compost a competitive fertilizer. In: Applying Compost: Benefits and Needs, Seminar Proceedings, Brussels, 22–23 November 2001, European Commission, pp. 111-115.

33-Woodward, L.; N. Lampkin (1990). Organic agriculture in the United Kingdom. p.19–29. In: Unwin R, ed. Proceedings of the Symposium on Crop Protection in Organic and Low Input Agriculture. Churchill College, Cambridge, UK.

34-Zebarth, B. J.; G. H. Neilsen; E. Hogue and D. Neilsen (1999). Influence of organic waste amendments on selected soil physical and chemical properties. Canadian J. of Soil Sci., 79:501-504.

35-Zwart, K. (2001). Fate of C and N pools-experience from short and long term compost experiments. *In:* Applying Compost: Benefits and Needs, Seminar Proceedings, Brussels,22–23 November 2001,European Commission, pp. 77-85.

مجلة الزراعة العراقية (البحثية) مجلد20 عدد1 ص192-205 تموز/2015

استجابة محصول الطماطة لإضافات الكومبوست والسماد العضوي السائل أثناء الرش الورقي أو الرسمدة

علي عبد فهد الطائي شعلان صالح ابراهيم حميد علي هدوان
سعدي ستار شحاذة محمد علي كاظم مصطفى فرقد عبد الحميد

المقدمة

الهدف الرئيسي من هذه الدراسة هو البحث في استجابة محصول الطماطة لممارسة الزراعة العضوية من خلال اضافة الكومبوست لتحسين بيئة التربة والأسمدة السائلة العضوية كمصدر للمغذيات. استخدم في الدراسة بيت بلاستيكي متعدد الفضاءات (36× 27.6م) الواقع في المزرعة الأرشادية التابع لوزارة الزراعة في الكوت، محافظة واسط، العراق للموسم الزراعي 2013/2012. تضمنت المعاملات الرئيسية إضافة الكومبوست بمعدل 20 و40طن متري هـ$^{-1}$ والمعاملات الثانوية إضافة السماد العضوي السائل عن طريق منظومة ري التنقيط (الرسمدة) أو الأضافة الورقية. التصميم المستخدم هو القطاعات كاملة التعشية بثلاث مكررات. تم انتاج الكومبوست في موقع الزراعة العضوية في الكوت وانتاج الأسمدة العضوية السائلة في موقع مشاريع الإدارة المتكاملة لإنتاج ووقاية المزروعات، بغداد التابع لوزارة الزراعة. أشارت النتائج أن كلاً من معدلات اضافة الكومبوست 20 40 طن متري هـ$^{-1}$ كانت كافية في تحسين خصائص التربة ونمو النبات. كانت طريقتي اضافة السماد العضوي السائل (الرسمدة أو الرش الورقي) متقاربة في تأثيرها في محصول الطماطة. على الرغم من أن التسميد الورقي ارتبط مع استخدام جرعة منخفضة لـ N، أنتج حاصل مقارباً الى المنتج من استخدام الرسمدة المرتبط بجرعة عالية من N. أشار تحليل العناصر الغذائية الكبرى N، P وK في التربة وكذلك الأشكال المعدنية للنايتروجين (NH_4 وNO_3) الى عدم وجود فروق معنوية بين المعاملات عند منتصف الموسم وبعد الحصاد. أشارت النتائج أيضاً إلى أن 20 طن متري كومبوست هـ$^{-1}$ كانت كافية لتزويد المحصول باحتياجاته من N ، P وK والحفاظ على تركيزات ملموسة خلال موسم النمو. لوحظ ارتفاع نسبة المادة العضوية في التربة مع تقدم موسم النمو. من الواضح أن اضافة الكومبوست يكمله اضافة السماد العضوي السائل كانت ممارسة ناجحة لتلبية احتياجات المحصول من المغذيات وزيادة الحاصل.

دائرة وقاية المزروعات– وزارة الزراعة– بغداد، العراق