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Behavior of Some Micro nutrients in Clay Loam Soil and the Organs of Tomato Plants as Affected by Different Fertilizers Ratios

[1]Malak A.E. Ramadan, A.M., [2]El-Bassiony and [3]Emad A. Al-Ashkar

[1]Soil and Water Use Dept., National Research Centre, Cairo, Egypt.
[2]Vegetable Researches Dept., National Research Centre, Cairo, Egypt.
[3]Spectroscopy Dept. National Research Centre, Cairo, Egypt.

Abstract: Field experiment was carried out in 2005 season at Banha (Qalubia Governorate), Egypt to study the effect of different rates of poultry manure and mineral fertilizers on growth, yield of tomato and the behaviour of micronutrients in soil and two tomato c.v.s. In all treatments the available micronutrients in soil decreases with plantation. The available Fe, Cu and Mn in soil decreasing with Alisa c.v. except in case of using 50% from the two fertilizers type and in case of using 25% chicken manure plus 75% mineral fertilizers. Obtained data showed that using 50% poultry manure plus 50% mineral fertilizer or 75% poultry manure plus 25% mineral fertilizer increases significantly all vegetative growth characteristics (plant length, number of leaves/plant and number of shoots/plants). The highest fruit yield was found by 75% poultry manure plus 25% mineral fertilizer. Iron, copper and manganese contents in organs of Alisa c.v. are more than the contents in GS12 organs except for leaves in all treatments.

Keywords: Micronutrients, Soil, Tomato, Mineral Fertilizer, Poultry Manure, Growth, Yield, GS12 c.v. and Elisa c.v.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the most important vegetable crop cultivated in Egypt. Organic manure such as poultry manure improve the behaviour of several elements in soils through that active groups (fluvic and humic acids) which have the ability to retain the elements in complex and chelate forms and consequently improve the plant growth and yield both qualitatively and quantitatively. Organic fertilizers are very important for providing the plants with their nutritional requirements without having any undesirable impacts on the environment. Salem[1] indicated that organic fertilizers improves the chemical properties and nutritional status of the soil, which may be due to decrease soil pH which lead to solubilization of nutrients and increases in nutrients availability and supply. However, Meravat and Dahdoh[2] reported that, the addition of organic manure improves the biological properties of the soil by increasing the populations and activities of micro-organisms in the soil.

The effect of organic manure depends on its source which differs in characteristics such as C/N ratio and available macro and micro nutrients[3]. Organic manure such as poultry manure is a good source of nutrients and contains both macro and micro nutrients essential for plant growth[4, 5]. However, poultry manure improves directly growth and yield of tomato plants.

Many investigators studied the effect of organic, mineral and bio-fertilization on growth, yield and quality of tomato plants[6,10]. Warman[8] found that the addition of chicken manure increased the total yield of tomato plants.

This work aims to replace mineral fertilizers partly or completely with poultry manure and their relationships with growth and yield of tomato plant c.v.s. GS12 and Elisa. Also the behaviour of micronutrients in two tomato plant c.v.s orangs.

MATERIALS AND METHODS

This experiments was carried in 2005 summer season at Banha (Qalubia Governorate), Egypt to study the effect of different ratios of poultry manure and mineral fertilizers on the growth and yield of tow cultivars of tomato plants (GS 12 and Elisa). Also the behaviour of micronutrients in the two tomato cultivars plant organs. Treatments are as follows:

- 100% poultry manure.
- 75% poultry manure plus 25% mineral fertilizer
- 50% poultry manure plus 50% mineral fertilizer.
- 25% poultry manure plus 75% mineral fertilizer
- 100% mineral fertilizer.

Corresponding Author: Malak A.E., Soil and Water Use Dept., National Research Centre, Cairo, Egypt.

Table 1: The physical and chemical analysis of the experimental soil and poultry manure

Characters	2005	
	Soil	Poultry manure
pH	7.85	7.77
EC (ds/m)	1.55	1.05
$CaCO_3$ %	1.4	
O.M. %	1.9	
ESP (%)	13.5	
CEC (meq/100g)	41.5	
Texture	Clay loam	
Nitrogen %	0.15	2.64
Phosphorus %	0.06	1.65
Potassium %	0.14	2.17
Total Fe µg/g	5844	2744
Total Mn µg/g	892	343
Total Cu µg/g	40	1.5

Seeds of two tomato plants (*Lycopersicon esculentum* Mill.) GS12 and Elisa were sown in foam trays with growing media of 1 peat: 1 vermiculite on 15 April and were transplanted into field.

Before cultivation, soil samples (0-60 cm) were analyzed for available and total elements. Ammonium acetate- EDTA mixture (pH = 4.65) was used to extract the available elements form[11]. Aqua Regia was used to digest soil samples for total contents of the investigated micronutrients[11].

The design of the experiment was split – plot with four replicates, where the poultry manure and mineral fertilizers ratios were distributed in the main plots and the varieties were arranged in the sub – plots. The plot area was 11.2 m^2 included 4 ridges, each with 70 cm. width and 4.0 m. long.

Poultry manure was analyzed for total micronutrients (Fe, Cu and Mn) using mixture of concentrated acids[11]. The normal agricultural treatments of growing tomato were practiced as usually followed in the commercial production of tomato. Poultry manure was added before sowing.

The physical and chemical properties of the experimental soil and poultry manure have been investigated and the results are presented in Table (1).

During the vegetative growth period, samples of four plants were taken at 80 days after sowing and the plant length, number of leaves and stem per plant. The fresh and dry weights of leaves, stems and roots were recorded. At harvest time, total fruit yield as ton/fed in each treatment was recorded. Also, soil samples were collected to represent each soil treatment to measure the available Cu, Fe and Mn. Plant samples were divided into roots, stem, leaves and fruit and digested by mixture of concentrated acids[11]. Iron, manganese and copper were determined in soil and plant organs applying micro-sampling technique. This could overcome the matrix and nebilization difficulties in high salt content sample solutions[12,13].

All the obtained data were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez[14].

RESULTS AND DISCUSSIONS

The Total Micronutrients in Soil Before Planting: Data in Table (1) reveals that total Fe, Mn and Cu in the experimental soil are higher than the values 25000, 500 and 20 µg/g respectively reported earlier[11]. The total Cu is less than total amount (5o µg/g), while Fe is higher than the total mentioned by Ewers[15].

Vegetative Growth:

Effect of Fertilization Treatments: Data in Table (2) show clearly that, using 100% mineral fertilizer or 75% poultry manure plus 25% mineral fertilizer increased significantly all vegetative growth characteristics (plant length, number of leaves/plant, number of shoots/plants and fresh weight of leaves and roots). In addition, higher fresh weight of stems and higher dry weight of leaves, stems and roots were obtained by 100% poultry manure or 75% poultry manure plus 25% mineral fertilizer. On the contrary, the lowest vegetative growth was obtained by using 25% poultry manure plus 75% mineral fertilizer.

It could be concluded that, the increase in plant growth obtained by poultry manure might be due to the improvement of physical and chemical properties of soil[16]. The favorable effect of organic manure beside mineral fertilizer on the vegetative growth of tomato plants was in agreement with previously obtained results[17,18] for tomato plants.

Effect of Varieties: Data in Table (2) obviously showed that, the highest vegetative growth characters (plant length, number of leaves, shoots/plant, fresh and dry weight of leaves and stems) were recorded by GS12 c.v. Whereas, fresh and dry weight of roots failed to reach the 5% level of significance.

It is clear also that the total yield of tomato fruits was significantly higher with GS12 c.v. compared with Elisa c.v.

Effect of the Interaction: The interaction between poultry manure and mineral fertilizers as well as varieties had a significant effect on vegetative growth characteristics except for fresh and dry weight of roots (Table 2). However, the highest plant length, number of leaves, shoots, plant and fresh weight of leaves for tomato plant were obtained by using 100% mineral fertilizer with GS12 c.v. Moreover, the highest fresh weight of stems and dry weight of leaves and stems were found by using 75% poultry manure plus 25% mineral fertilizer with GS12 c.v.

Also it is clear that the interaction between organic

Table 2: Effect of fertilizer treatments and varieties on growth and yield of tomato plants during 2005 season

		Plant length (cm)	No. of leaves/plant	No. of shoots /plant	Fresh weight			Dry weight			Total yield ton/fed.
					Leaves(g)	Stems(g)	Roots(g)	Leaves(g)	Stems(g)	Roots(g)	
					Fertilizers						
100%Mineral		44.34	30.83	5.34	37.17	25.24	7.26	8.92	3.34	1.58	19.50
100% Organic		41.00	24.84	4.34	28.32	27.12	5.22	11.22	4.58	2.45	21.30
25%organic +75%mineral		37.42	22.50	4.00	32.05	27.81	4.40	5.70	3.37	2.01	21.75
50%organic +50%mineral		44.50	24.50	4.34	32.24	22.90	5.48	8.71	4.61	2.03	22.00
75%organic +25%mineral		45.34	29.00	6.17	33.53	33.86	6.27	12.07	6.50	2.53	21.90
LSD at 5%		2.17	3.50	1.15	1.67	0.88	1.09	3.67	0.77	NS	0.34
					Varieties						
GS12		44.57	30.60	6.07	37.26	31.56	5.56	10.04	5.54	2.06	23.48
Elisa		40.47	22.07	3.60	28.06	23.21	5.89	8.59	3.42	2.18	19.10
L.S.D		2.12	5.78	2.46	3.90	6.63	NS	1.17	1.05	NS	2.57
					Interaction						
100%	GS12	50.67	45.33	7.67	45.99	28.31	9.01	12.66	4.49	1.73	21.40
Mineral	Elisa	38.00	16.33	3.00	28.35	22.17	5.51	5.17	2.19	1.42	17.60
100% Organic	GS12	51.00	29.00	6.67	37.08	31.76	5.60	11.02	5.02	2.55	23.90
	Elisa	31.00	20.67	2.00	19.55	22.48	4.84	11.41	4.14	2.34	18.70
25%organic	GS12	37.17	24.00	4.33	30.27	28.91	3.67	5.19	3.96	1.57	24.10
+75% mineral	Elisa	37.67	21.00	3.67	33.83	26.71	5.12	6.20	2.78	2.44	19.40
50% organic	GS12	40.00	20.00	4.67	34.16	19.95	4.13	6.78	4.41	1.64	23.60
+50% mineral	Elisa	49.00	29.00	4.00	30.32	25.85	6.82	10.63	4.81	2.41	20.40
75% organic	GS12	44.00	34.67	7.00	38.82	48.86	5.37	14.57	9.84	2.79	24.40
+25% mineral	Elisa	46.67	23.33	5.33	28.23	18.85	7.16	9.56	3.16	2.27	19.40
LSD at 5%	6.13	9.10	2.39	4.03	4.87	NS	1.67	2.31	NS	1.33	

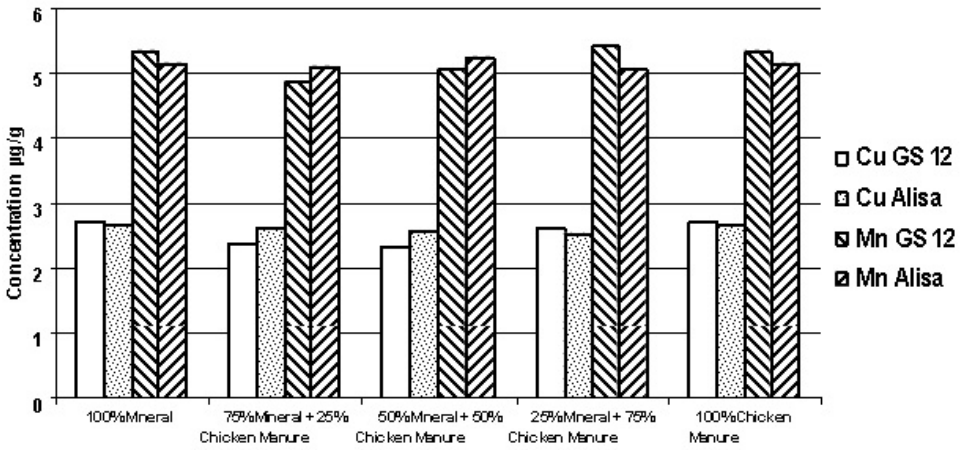

Fig. 1a: Concentration of available Cu and Mn in soil (µg/g)

and mineral fertilizer as well as varieties had a significant effect on the total yield of tomato fruits. The highest total yield was recorded with GS12 c.v. under 75% poultry manure plus 25% mineral fertilizers treatment.

Total Fruit Yield: Effect of fertilization treatments:

The results reported in Table (2) demonstrate clearly that, adding poultry manure mixed with mineral fertilizers increases significantly the total yield of tomato. The highest fruit yield was obtained by 50% poultry manure plus 50% mineral fertilizers or 75% poultry manure plus 25% mineral fertilizer. Meanwhile, the lowest total yield of tomato fruits was recorded by using 100% mineral fertilizer.

Effect of Verities: Total fruit yield was statistically influenced by verities. GS12 c.v. recorded higher and

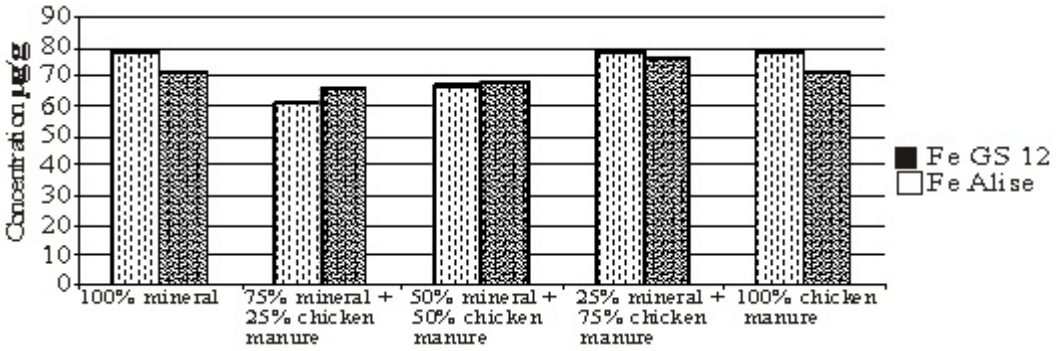

Fig. 1b: Concentration of available Fe in soil (µg/g)

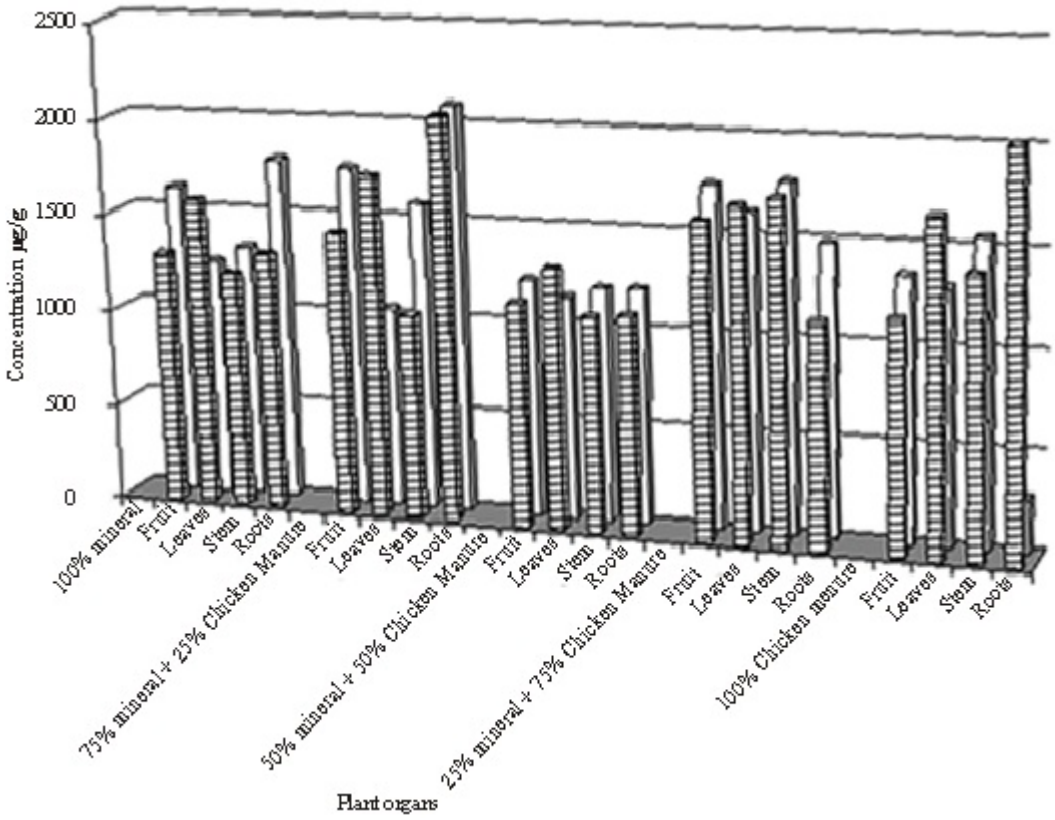

Fig. 2: Concentration of Fe in two variable of Tomato organs under different treatments.

significant fruit yield compared with Elisa c.v. This increase might be due to the higher vegetative growth and nutrient absorption of GS12 c.v. which accumulate more synthesis and consequently more fruit yield.

Effect of Interaction: Higher fruit yield was recorded by GS12 c.v. when its plants were fertilized by poultry manure when it was applied alone or mixed with 25%, 50% and 75% mineral fertilizers.

The increase of total yield of tomato fruits resulting by poultry manure may be attributed to that organic manure enhances soil aggregation, soil aeration and increasing water holding capacity at the soil which offers good environmental conditions for the root system of tomatoes. In addition, organic manures are slow release nutrients allover the growth season. Poultry manure is rich in its nitrogen and nutrients content[9,10] for tomato plants.

The Available Micro nutrients in Soil under Different Treatments: In all treatments, the available micronutrients in soil decreases with plantation. Also the available Fe, Cu and Mn in soil decreases with

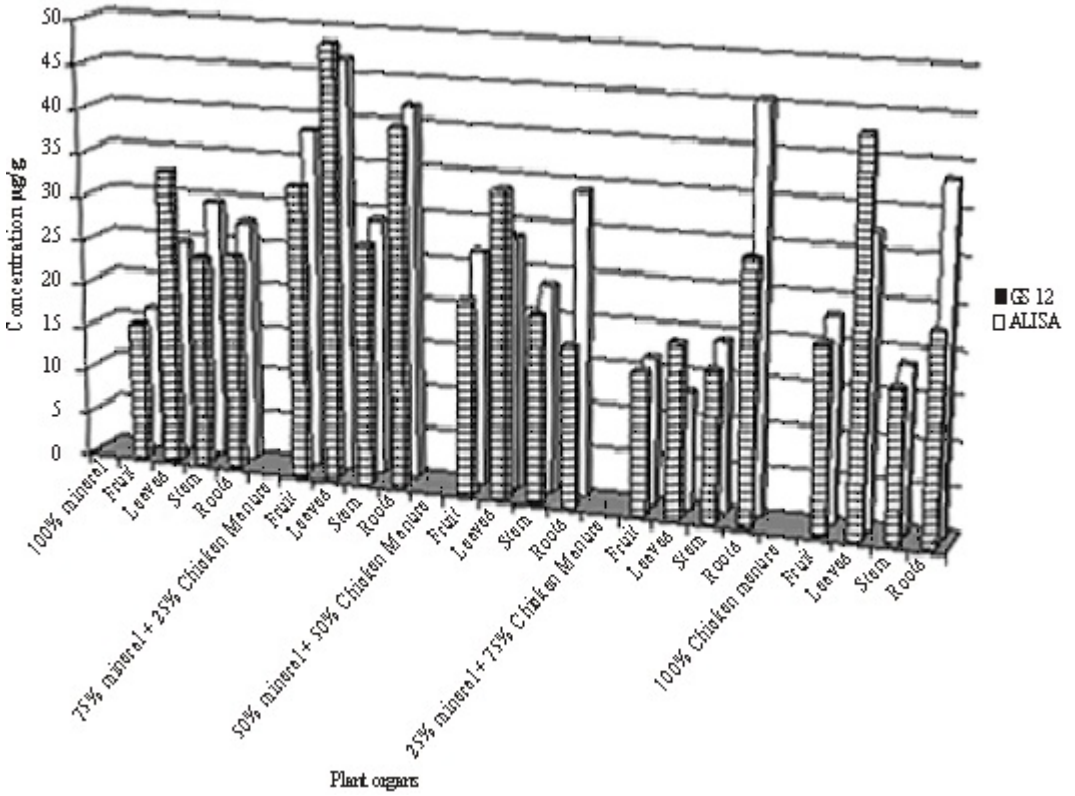

Fig. 3: Concentration of Cu in two varieties of Tomato organs under different treatment.

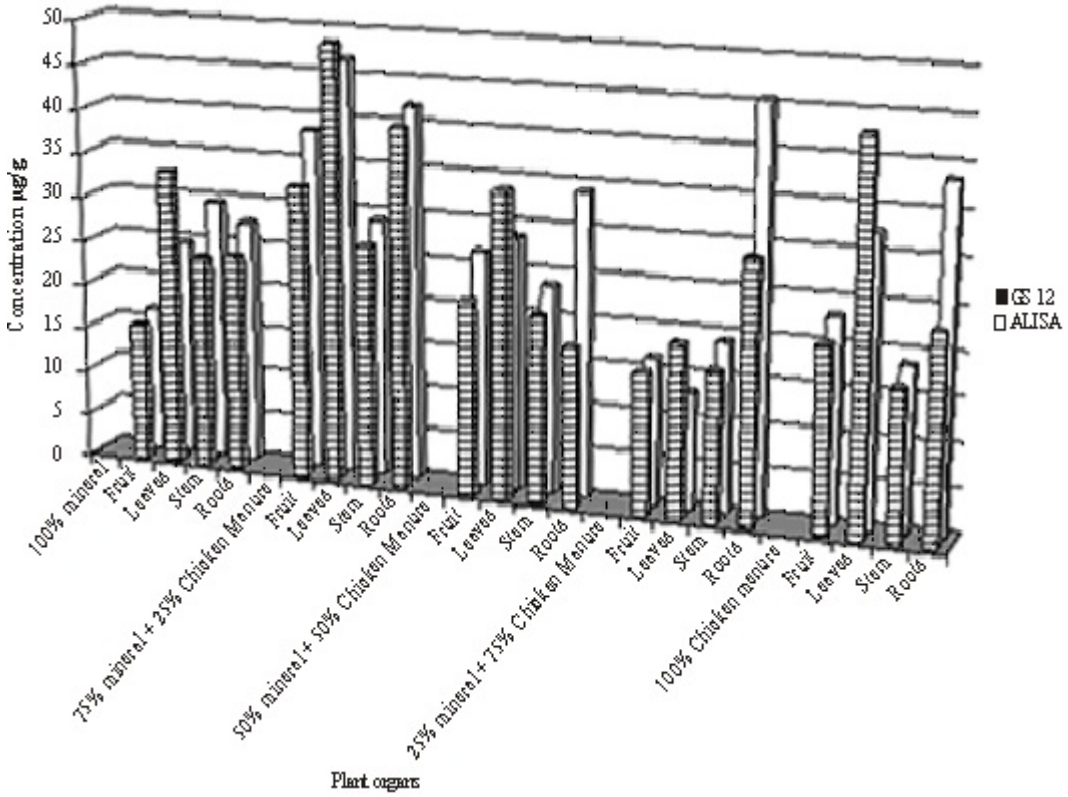

Fig. 4: Concentration of Fe in two varieties of Tomato organs under different treatment.

Alisa variety except in case of using 50% of the two fertilizers type and in case of using 25% poultry manure plus 75% mineral fertilizers, (Fig 1 a & b).

The available Fe is more than the adequate amount (4.5 µg/g)[19]. Also the measured values are lower than tolerable limit (500 µg/g soil) mentioned by Tietjen[20].

The available Cu is more than the adequate amount (0.2 µg/g) according to Follet and Lindsay[19]. The available Cu in soil lies in the range of common concentration (1.0 µg/g – 20 µg/g) and lower than the maximum tolerable concentration (100 µg/g)[15], while they are in range (1.86 µg/g to 2.5 µg/g) of nonpolluted soils of Egypt[21]. They are in the range (0.002 µg/g to 180 µg/g) of normal soil [22]. According to Follet and Lindsay[19], the measured available Mn are very high than the reported value (>1.0 µg/g), while they are lower than the maximum tolerable concentration (300 µg/g) [15]. Also they lie within the normal range (15 to 1250 µg/g) mentioned by Liphadzi *et al.,*[22].

The Behavior of Micro nutrients in Two Varieties of Tomato Oranges under Different Rates of Mineral Fertilizers and Poultry Manure: The iron, copper and manganese contents in Alisa organs are more than the contents in GS12 organs except for leaves in all treatments, (Fig 2, 3 and 4).

The Comparison of Micro nutrients in Two Varieties of Tomato Organs with Critical Levels: The contents of iron in all organs are more than the normal concentration of iron (25 to 300 µg/g) mentioned by Besson[23] and Chapman[24] also by Chaney[25] (30 to 300 µg/g dry foliage). Iron contents are higher than the critical toxicity (400- 1000 µg/g in plant tissues)[26]. Also they are more than the maximum levels tolerated by cattle, chicken (1000 µg/g) and sheep (500 µg/g)[25].

In all organs of the two varieties under different treatments, the manganese contents are in normal ranges (25- 300 µg/g) according to Beeson[23], and Chapman[24]. Also they are in range (15- 150 µg/g) except for the contents in roots where are higher according to Chaney[25].

Under different treatments, the copper contents in two varieties of tomato organs are in range of normal concentration (4 to 40 µg/g)[23, 24] except the leaves of GS12 in case of using 100% chicken manure, the Alisa roots in case of using 75% chicken manure plus 25% mineral fertilizers, the roots and leaves of two varieties in case of using 25% chicken manure plus 75% mineral fertilizers, copper contents are in ranges of phytotoxic level (10- 70))[27] and (20- 100 µg/g)[28]. Also they are more than the maximum level tolerated by sheep (25µg/g) reported by Chaney[25].

Conclusion: In case of soil polluted with micronutrient, it is not recommended to cultivate Alisa c.v. of tomato which accumulates micronutrient in its organs, while it is recommended to cultivate GS12 c.v.

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