



Effect of Organic compost on Chemical Parameters for Two Varieties of Tomato Plant (*Solanum esculentum* L.)

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Abstract: The experiment conducted during 2018-2019 to study effect of added 15 and 30 t.h⁻¹ level of three kinds of decomposing organic fertilizers on some chemical properties for two varieties of tomato (Red flower F1 and Waad RZ) in field of agricultural experiments station college of Agriculture, University of Basrah. Results showed a significantly effect of hybrid (Red flower F1) compared with hybrid (Waad RZ) on leaves content of : Total chlorophyll, total N and total soluble carbohydrate, increased 10.6, 14.39 and 8.84% respectively. Results showed a significant effect of organic fertilizer especially 15 t.ha⁻¹ poultry fertilizer on total chlorophyll and total N in leaves content with increase of 67.75 and 110.31% respectively, 30 t.ha⁻¹ poultry fertilizer significantly increased of total P in leaves content increased 143.48%. Decomposing cattle fertilizer with 30 t.ha⁻¹ significantly increased of total K in leaves content with increased 181.30% also corn residues fertilizer with 30 t.ha⁻¹ significantly increased of total soluble carbohydrate with 109.89%. Interaction between experiment factors were significantly effect on total chlorophyll, K and soluble carbohydrate in leaves content. Study also revealed different influences of organic fertilizer as follow: The poultry fertilizer (15 t.ha⁻¹) increased the total leaves content of chlorophyll and N with 67.75 and 110.31% respectively. While the poultry fertilizer (30 t.ha⁻¹) significantly increased the total leaves content of P with 143.48%. The decomposed cattle fertilizer (30 t.ha⁻¹) significantly increased the total leaves content of K with 181.30%. Whereas corn residues (30 t.ha⁻¹) significantly raised the total leaves content of soluble carbohydrate with 109.89%.

Key words: Decomposing organic fertilizer, Hybrid tomato, Greenhouses.

Introduction

Tomato crop (*Solanum esculentum* L.) is one of an important vegetables crop locally and the entire world, due to its high nutritional value. Where, each 100gm of tomato fruit contains vitamin A, vitamin B1, vitamin B2, vitamin B3 and vitamin C. Also, calcium, phosphorus, potassium and iron, besides that, tomato contains protein and carbohydrate

(Watt & Merrill, 1963). However, Lycopene content in tomato increasing the importance of consuming it; where, the lycopene is useful to decrease the risk of cancer disease and especially the prostate cancer (Takeoka *et al.*, 2001).

At the present time, many researchers investigated the effect of using organic

fertilizer on different cultivated plants, especially the tomato which needs high organic matters in the soil to encourage the plants to reach the maximum productivity (Baldock & Nelson, 2000).

The organic matter of animal residuals is one of best nutrition system that can effect positively on physical, chemical and biological soil properties, however, this type of organic fertilizer supplies nutrients such as N, P and K as well as micronutrients to the soil (Afzel & Adams, 1992). Al-Amery & Matlob (2012) found that using of 5% residuals of cattle, sheep and poultry with 30cm deep for tomato, increased the leaves total leaves contents of chlorophyll, N, P and K. This study aimed to select the appropriate kind of organic fertilizers for the two hybrids of tomato cultivated under the southern Iraq.

A greenhouse experiment was conducted during the winter season year 2018-2019 at Researcher Station, College of Agriculture, University of Basrah to study the effect of three kinds of organic fertilizers (Poultry, cattalo and corn residues) in addition to control on some chemical properties of two varieties of tomato hybrids. The greenhouse specifications is (50 × 9m) with 450 m².

The soil used for this study was classified as: Entisol, typical quartz pasmment according to (Bollago & Huang,1998). The soil of greenhouse was plowed three times and then settled. A randomized sample was taken from surface 0-30cm to determine the physical and chemical properties (Table 1). The analysis had been conducted in the Central Lab., College of Agriculture, University of Basrah.

Materials & Methods

Table (1). Some chemicals and physicals properties of soil experimental and irrigation water.

Properties		Value
pH		7.51
E.C. (Ds.m ⁻¹)		6.50
Soluble captions (Mmol.l ⁻¹)	Ca ⁺²	31.14
	Mg ⁺²	26.88
	Na ⁺²	2.12
	K ⁺	1.14
O.M.		0.63
Soluble anions Mmol.l ⁻¹	HCO ³	23.22
	CO ³	-
	SO ₄ ⁻²	26.32
	Cl ⁻	9.66
Total N (g.kg ⁻¹)		22.2
Available P (g.kg ⁻¹)		0.015
C.E.C (g.kg ⁻¹)		17.33
Soil separated (%)	Sand	12.20
	Silt	42.7
	Clay	45.1
Texture		Silty clay
Weight soil humidity (%)		6.67
Soil humidity at field capacity (%)		30.13
Irrigation water		
E.C. Ds.m ⁻¹		1.20
pH		7.30

Design of experiment

Greenhouse soil was plowing with disc plow twice time and divided after levelling to 6 main lines with 30cm deep against north wind direction to provide greenhouse plastic damage by wind. Each line was 45m divided

to seven experiment units as 6m for one experiment unit and left out 0.5m between experiment unit and other. The distance between lines was 1.30m and left out 2.5m at front and end of greenhouse as a service area. Temperature was recorded during experiment period (Table 2).

Table (2). Tenth mean of Max. and min. temperature and relative humidity during experiment

Date	Max. Temperature C°	Min. Temperature C°	Relative Humidity (%)
1 - 10 Sep, 2018	45.23	27.85	20.20
11- 20 Sep, 2018	43.25	24.25	16.34
21 - 30 Sep, 2018	38.21	22.54	22.43
1 - 10 Oct, 2018	35.94	19.44	22.04
11- 20 Oct, 2018	35.26	16.85	23.42
21 - 30 Oct, 2018	30.02	15.71	33.25
1 - 10 Nov, 2018	26.87	16.27	61.05
11-20 Nov 2018	23.89	15.61	72.46
21-30 Nov 2018	22.39	12.64	73.58
1-12 Oct 2018	21.63	11.27	67.22
11-20 Dec 2018	15.70	5.79	59.77
21-30 Dec 2018	17.17	3.48	54.41
1-10 Jan 2019	15.60	6.68	74.46
11-20 Jan 2019	15.09	6.01	79.25
21-30 Jan 2019	18.27	8.30	77.01
1-10 Feb 2019	15.79	6.64	68.56
11-20 Feb 2019	19.85	5.27	53.27
21-30 Feb 2019	24.60	10.31	55.43
1-10 Mar 2019	27.80	13.23	50.28
11-20 Mar 2019	25.01	13.30	64.55
21-30 Mar 2019	29.08	13.59	38.63
1-10 Apr 2019	30.83	18.93	45.41
11-20 Apr 2019	29.12	14.23	41.15
21-30 Apr 2019	35.43	21.25	30.47

The organic residuals for cattle and poultry were collected from animal field belonging to College of Agriculture, University of Basrah, while the corn plant residuals were collected from private farmers fields. Each kinds of residual were stacked in heap inside the concrete basin (6m × 3m × 1.5m) . Water was

added to this heap to wet the organic residuals matters, and then these concrete basins were covered for (12 weeks). Organic residuals were flipping each two weeks to homogenize during the incubation period. At the ending of composting process, sample of each kind of compost was taken to analyse (Table 3).

Table (3): Some chemical properties of organic fertilizers used in experiment.

Properties	Composite		Poultry residual		Cattle residual	
	Before decomposing	After decomposing	Before decomposing	After decomposing	Before decomposing	After decomposing
pH	7.2	7.1	6.7	7.1	6.5	6.6
E.C Ds.m ⁻¹	9	9.5	10.25	11	2.2	2.6
Organic C (g.kg ⁻¹)	226.5	236.6	311.14	327.40	66.12	74.5
Total N (g.kg ⁻¹)	6.5	11	20.1	24.2	2.55	3.15
Total P (g.kg ⁻¹)	9.81	11.14	13.4	17.16	1.6	2.11
Total K (g.kg ⁻¹)	7.14	4.20	5.12	3.3	2.5	1.2
O.M. %	142.69	149.05	196.01	206.26	41.65	46.93

Laboratory Analysis

Two types of tomato hybrids have been used in this study these are : Red flower R1 from USA and Waad RZ from Netherland Seeds of two hybrids were sown on September/2018 in Styrofoam seedling tray after treated with effective fungicide to avoid having fungal disease in the first place. After the seedling reached appropriate size on the first of October 2018, were moved to the field inside the greenhouse with a distance 50cm between each plant. Dripper irrigation had been used for all experimental plants under this study. All agricultural services were applied to the experimental area and plants according to Al-Mohamedy & Jasiem (1989). The experiment was conducted as a factorial split plots design according to randomized block with three replicates. The two hybrids of Tomato (Waad and Red flower) considered as a main factor

(main-plot), while the organic fertilizer as a secondary factor (Sub-plot) that include 15 and 30 Ton..ha⁻¹ of the compost of poultry, cattle and corn respectively, beside the control treatment.

The result data was analysed statically using the Gen-stat software. The least significant differences test (L.S.D.) at 0.05 has been used according to Al-Rawi & Khalefallah, (1980).

Chemical analysis

A five tomato plants were selected randomly from each experimental units to measured chemical properties of plants as follow :

1- Chlorophyll content in leaves (mg. 100gm wet weight⁻¹):-

Total chlorophyll was measured in the fourth wet leave by extractable method as describes by Goodwin (1976), according to equation:

$$\text{Total chlorophyll (mg/ L)} = 20.2 D(645 \text{ nm}) + 8.02 D(663\text{nm})$$

where: D = extractable chlorophyll light density, conversion from (mg. L⁻¹) unit to (mg.100g⁻¹) use correlation described by Zaehringer *et al.* (1974):

$$\text{mg.100gm}^{-1} = \frac{\text{mg.L}^{-1}}{1000 \text{ ml}} \times \frac{100}{\text{sample wiaght (gm)}}$$

2- Total Nitrogen (%)

Selected leaves were dried and digested according to Cresser & Parsans (1979); while using the Micro-Kjeldahl method to measure the total nitrogen (Jackson, 1958).

3- Total phosphorus in leaves (%)

Using spectrophotometer on 882 nm according to Olsen & Summes (1982).

4- Total potassium in leaves (%)

Using flame photometer according to Al-Sahaf (1989).

5- Total soluble carbohydrate in leaves (mg.100gm⁻¹ Dry matter)

As stated in the method of Abbas & Abbas(1992)

Results & Discussion

1- Effect of organic matter and varieties on total chlorophyll content in leaves (mg. 100gm fresh weight⁻¹)

Data in table (4) explained that the 15ton. ha⁻¹ of poultry compost increased significantly the chlorophyll content for leaves with a

proportion 67.75, 0.44, 16.40, 24.90 and 22.85% in compared with other compost treatments. Other compost treatments appeared a significantly rise in chlorophyll content of leaves in contrast with control.

The tomato hybrid (Red flower R1) exhibit significant superiority on leaves content of total chlorophyll in comparison with (Waad RZ) hybrid by 10.60%.

Results also revealed the significant superiority of chlorophyll content (58.05 mg.100gm⁻¹ fresh wet) for tomato hybrid (Red flower R1) leaves grown in soil involved with 15 t.ha⁻¹from poultry organic compost.

The Interaction between factors under study, which appeared significantly increasing on total chlorophyll in leaves of tomato plant (Red flower R1 hybrid) that grown in 15 t.ha⁻¹ of poultry fertilizer.

2-Effect of organic matter and hybrid on total N (%)

Table (5) revealed supremacy effect of hybrid type (Red flower R1) in to nitrogen of leaves by 14.39% .

Table (4): Effect of hybrid and fertilizer treatments and interactions in the total of chlorophyll (mg.100g⁻¹ fresh wet).

Fertilizer factor effect (t.ha ⁻¹)	Hybrid effect		Fertilizer factors mean effect
	Waad RZ	Red flower F1	
Control	30.27	34.97	32.62
Poultry (15 t.ha ⁻¹)	51.38	58.05	54.72
Poultry (30 t.ha ⁻¹)	53.23	55.74	54.48
Cattle (15 t.ha ⁻¹)	64.01	48.01	47.01
Cattle (30 t.ha ⁻¹)	43.43	54.53	48.99
Plant compost (15 t.ha ⁻¹)	42.72	44.89	43.81
Plant compost (30 t.ha ⁻¹)	42.70	46.38	44.54
Hybrid effect	44.25	48.94	---
L.S.D. (0.05)	Hybrid	Fertilizer treatments	Interaction
	0.80	1.56	2.07

Table (5) also showed that addition of 15 ton/ha of poultry compost increased Effectively of the percentage nitrogen content in tomato leaves (110.3 %) in compared with other compost treatments as follow: Control (8.42%), 30 ton. ha⁻¹ (24.62%), 15 ton. ha⁻¹

cattle (19.95%), 30 ton. ha⁻¹ cattle (29.68%) and (15,30) ton. ha⁻¹ corn (24.62%). However, result did not detect any significant effect of interaction between two tomato hybrids used in this study.

Table (5): Effect of hybrid and fertilizer treatments and interactions in the total of nitrogen of tomato plant (%).

Fertilizer factor effect (t.ha ⁻¹)	Hybrid effect		Fertilizer factors mean effect
	Waad RZ	Red flower F1	
Control	3.15	3.82	3.49
Poultry (15 t.ha ⁻¹)	6.78	7.89	7.34
Poultry (30 t.ha ⁻¹)	6.48	7.06	6.77
Cattle (15 t.ha ⁻¹)	5.33	6.44	5.89
Cattle (30 t.ha ⁻¹)	6.00	6.77	6.38
Plant compost (15 t.ha ⁻¹)	5.38	5.94	5.66
Plant compost (30 t.ha ⁻¹)	5.33	6.44	5.89
Hybrid effect	5.49	6.34	----
L.S.D. (0.05)	Hybrid	Fertilizer treatments	Interaction
	0.67	0.37	N.S

3- Total P (%)

Data of table (6) indicated that addition of 30 ton/ha of poultry compost increased effectively of the percentage phosphorus content in tomato leaves (143.48 %) in compare with other compost treatments as follow: control (9.80%), 15 ton/ha poultry (21.74 %), 15 ton/ha cattle (16.76%), 30 ton/ha cattle (30.23 %) and (15,30) ton/ha corn (21.74%). Result also did not detect any significant effect of interaction between two tomato hybrids.

4- Total K (%)

Result in table (7) demonstrated that supplement tomato plants with 30 ton/ha of poultry compost increased effectively of the percentage potassium content in their leaves

(181.30%) in compare with other compost organic composts used in this study as follow: control (23.13%), 15 t.ha⁻¹ poultry (18.08%), 15 t.ha⁻¹ cattle (16.49%), 30 t.ha⁻¹cattle (119.68%) and (15 and 30) t.ha⁻¹corn (35.95%). Result also did not detect any significant effect of interaction between two tomato hybrids.

Result also showed a significantly raised of total potassium content with 7.24% for the (Red flower R1) hybrid leaves plants grown in soil that have 30 t.ha⁻¹ of cattalo compost (Table 7).

Table (6). Effect of hybrid and fertilizer treatments and interactions in the total of phosphorus of tomato plant (%)

Fertilizer factor effect (t.ha ⁻¹)	Hybrid effect		Fertilizer factors mean effect
	Waad RZ	Red flower F1	
Control	0.24	0.23	0.23
Poultry (15 t.ha ⁻¹)	0.51	0.52	0.51
Poultry (30 t.ha ⁻¹)	0.57	0.55	0.56
Cattle (15 t.ha ⁻¹)	0.45	0.47	0.46
Cattle (30 t.ha ⁻¹)	0.47	0.48	0.48
Plant compost (15 t.ha ⁻¹)	0.42	0.44	0.43
Plant compost (30 t.ha ⁻¹)	0.46	0.47	0.46
Hybrid effect	0.44	0.45	---
L.S.D. (0.05)	Hybrid	Fertilizer treatments	Interaction
	N.S	0.02	N.S

Table (7): Effect of hybrid and fertilizer treatments and interactions in the total of potassium of tomato plant (%).

Fertilizer factor effect (t.ha ⁻¹)	Hybrid effect		Fertilizer factors mean effect
	Waad RZ	Red flower F1	
Control	2.57	2.36	2.46
Poultry (15 t.ha ⁻¹)	6.63	4.61	5.62
Poultry (30 t.ha ⁻¹)	6.05	5.68	5.86
Cattle (15 t.ha ⁻¹)	5.83	6.05	5.94
Cattle (30 t.ha ⁻¹)	6.61	7.24	6.92
Plant compost (15 t.ha ⁻¹)	3.24	3.06	3.15
Plant compost (30 t.ha ⁻¹)	5.86	4.32	5.09
Hybrid effect	5.25	4.87	---
L.S.D. (0.05)	Hybrid	Fertilizer treatments	Interaction
	N.S	0.47	1.14

5- Total soluble carbohydrate (mg. gm⁻¹ Dry matter)

Total soluble carbohydrate content of tomato hybrid (Waad RZ) leaves presented in table (8) showed increased with 8.84%. Result in table (8) revealed that tomato plants grown on 30 t.ha⁻¹ of corn compost fertilizer increased effectively the total soluble carbohydrate

content in their leaves (109.89%) in compare with other organic composts used in this study as follow: control (38.33%), 15 ton. ha⁻¹ poultry (21.23%), 30 ton. ha⁻¹ (30.15%), 15 ton. ha⁻¹ cattle (25.74%), 30 ton. ha⁻¹ cattle and 15 ton. ha⁻¹ corn (1.66%). Result also demonstrated a significantly hike of total soluble carbohydrate content in the leaves

523.9 mg. gm⁻¹ D.W. for tomato hybrid (Waad RZ) grown in soil that have 30 t.ha⁻¹ of plant compost (Table 8).

Data in tables (4, 7 and 8) showed significantly affect between two tomato hybrid in the total leaves content of chlorophyll, potassium and soluble carbohydrate. Variance in these proprieties may be due to the genetic variability between the two hybrids in addition to response to the

climate conditions. The results agreed with results of Al-Abadi (2012).

Data in tables (4, 5 and 6) showed increasing in nitrogen and phosphorus, when plant grown in soil contain poultry fertilizer. The organic matter considered as an important factor for the minerals availability in soil solution, and this help the plant to increase the nutrients absorption . (Tisdal *et al.*, 1995).

Table (8). Effect of hybrid and fertilizer treatments and interactions in the total of soluble carbohydrates (mg. gm⁻¹ dry matter)

Fertilizer factor effect (t.ha ⁻¹)	Hybrid effect		Fertilizer factors mean effect
	Waad RZ	Red flower F1	
Control	218.9	276.3	247.6
Poultry (15 t.ha ⁻¹)	423.1	328.3	375.7
Poultry (30 t.ha ⁻¹)	459.9	397.5	428.7
Cattle (15 t.ha ⁻¹)	312.2	486.3	399.3
Cattle (30 t.ha ⁻¹)	323.8	52.9	413.3
Plant compost (15 t.ha ⁻¹)	519.6	502.9	511.2
Plant compost (30 t.ha ⁻¹)	515.4	523.9	519.7
Hybrid effect	396.1	431.1	---
L.S.D. (0.05)	Hybrid	Fertilizer treatments	Interaction
	23.99	14.40	22.59

Al-Amery & Matlob (2012) reported that addition of poultry compost improved the chemical properties of the soil through increased nitrogen rates to soil solution, and thus in turn increased of nitrogen accumulation in plant tissue. On the other hand, the high Nitrogen rate increment the formation of chlorophyll and amino acids in the chloroplast (Gutierrez -Micelli *et al.*, 2007). Also, Peter & Reson (2005) confirmed that the in leaves.

The addition of organic fertilizer leads to raise the phosphorus rate in leaf through

percentage of Nitrogen concentrated increased the uptake it by plant. The increasing the availability of phosphorus in the soil, may due to increase the solubility and release of phosphate in the organic compost (Al-Arkawazi, 2000). This results agreed with results of Ewulo *et al.* (2008) on tomato plant.

Data in table (7) displayed that addition 30 t.ha⁻¹ of decomposing cow fertilizer cause a high increasing in potassium percentage in tomato leaves. The reason may due to the elements supplements from residuals fertilizer and increased its availability in soil solution, that easily uptake by plants (Table 3); beside

decreased leaching nutrient element from soil solution due to chelating combination of organic acid from analysis organic matter (Zink & Allen, 1998; Meena *et al.*, 2007).

Table (8) exhibited that addition of corn compost affect a significantly increasing in total soluble carbohydrate in tomato leaves, this may be due to role of corn compost to supply soil solution with elements and especially the macronutrients. So that increased absorption of plants to these elements. These elements play an active role in reactive enzymes in photosynthesis process and causing the increment of total soluble carbohydrate in tomato leaves (Al-Shahwani, 2006). These results are in line with the observations of Al-Amery & Matlob (2012).

Conclusions

We conclude that addition of organic fertilizers (poultry fertilizer at rate 15 t.ha⁻¹ or cowing manure compost with a rate 30t.ha⁻¹) led to improve all chemical characteristics of both tomato hybrids under study. Also present investigation found that the chemical characteristics of both tomato hybrids (Red flower F1 and Waad RZand) are significantly different. However, the study recommended searching a new tomato hybrid more suitable to environmental conditions in Basrah.

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