THE POSSIBLE RESPONSE OF TOMATO GROWTH AND FRUIT QUAITY FOR APPLYING A WATER SOAKING SOLUTION OF POULTRY WASTES THROUGH DRIP IRRIGATION SYSTEM

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ABSTRACT

This study aims to identify the possible use of poultry wastes soaking solution mixed with saline irrigation water through a drip irrigation system to alleviate the hazardous effect of water salinity stress on tomato yield (*Lycopersicon esculentum*, 1077 El-Basha hybrid cv.) and fruit quality. The experiment was carried out during two successive seasons of 2009 and 2010 on a sandy soil represents one of the private farms of the Western Desert Outskirt of Beni-Suef Governorate, Egypt. The studied soil is mainly encompassing the aoelian sediments that occupying the western desert zone rime the Nile Valley. The obtained data reveal that the studied soil could be classified as Typic Torripsamments, siliceous, hyperthermic as well as categorized as marginally suitable ($S3s_1$) for irrigated agriculture land, with soil texture as a soil limitation for productivity. Also, it is evaluated as a marginally suitable for cultivating tomato plants in the current and potential conditions, with also a soil texture as a soil limitation for tomato productivity. The applied irrigation water represents a mixture of saline water of EC=1.87 dS/m and SAR=5.91, where it is classified as C2S1.

The poultry wastes soaking solution was not only applied to alleviate the harmful effect of water salinity stress on vegetative growth, yield and its components of tomato but also as supplementary doses of organic- N for a partial substitution of N-mineral with ratios of 25, 50 and 75 % of N-mineral recommended dose. Also, the obtained results showed that usage of the amended saline water with poultry wastes soaking solution resulted in ameliorating some soil properties, *i.e.,* bulk density, total porosity, available water range, hydraulic conductivity, organic matter, pH, CEC, ECe, ESP and available nutrient contents). Under such actual favourable soil conditions, the vegetative growth parameters of tomato plants, *i.e.,* plant height, number of leaves/plant, thickness of shoot/plant at soil surface, number of branches/plant, leaf area, dry weight/plant, leaf chlorophyll a & b concentration, leaf content of NPK, number of both inflorescences and flowers/plant, which were positively affected by the amended irrigation saline water with poultry wastes soaking solution. It is evidently that such beneficial impact of such active organic substances on the dry matter production and accumulation in plant tissues was more attributed to the increases in leaves area and number, which are contributed to more photosynthesis and better carbohydrates yield. Whether, the mechanism of these organic substances on stimulating growth was similar to plant growth regulators.

In general, mixing poultry wastes soaking solution with saline irrigation water through a drip irrigation system registered a higher tomato fruit yield with high quality due to the continuously supplementary among the different growth stages of plant. Such relative increases could be attributed to significantly higher increments in dry weights and number of flowers per plant, which positively reflected on the higher number of tomato fruit and yield per plant and fed. The parameters of tomato fruit quality were fruit yield/plant, number of fruits/plant, average weight of fruit, fruit content of citric acid and total soluble solids (TSS). These plant parameters showed significant increases with amended saline irrigation water with poultry soaking solution as compared to the control treatment (100% mineral N) . This may be due to such solution was enriched in active organic substances that control many stress adaptation responses including stomatal closure, osmotic adjustment, ion compartimentation, and regulation of shoot versus root growth and modifications of root hydraulic conductivity properties. Also, the ability of these organic substances to increase the nutrients uptake by plant roots, mainly due to their chelating property. The later makes the nutrients more available to plants, owing to their ability to enhance cell permeability that making more rapid entry of nutrients into plant cells.

Key words: Outskirt desert soils, drip irrigation system, saline irrigation water, water soaking solution of poultry wastes and tomato.

INTRODUCTION

Crop production, in terms of quality and quantity, is a function of many factors directing soil fertility aspects, particularly plant nutrition and therefore suitable fertilization system. That is true, since hybrid varieties were densely used in agriculture policy of Egypt, which showed that the use of N fertilizer has increased greatly day by day. On the other hand, the excessive nitrogenous fertilizer uses carry potential risks to environmental pollution of soil and either surface water sources or natural underground waters as well as agricultural products, which negatively affect the human health **(Marilla *et al.*, 2004, Gallardo *et al.*, 2005)**. Undoubtedly, human health as related to environmental quality could be settled under danger because of the polluted soil and water resources with residual effect of nitrogenous fertilizers. However, part of the nitrogen fertilizer which could be absorbed by plants enters into a cycle in which chemical and biological processes occur. This cycle shows a great variety depending on the soil texture, climate conditions, land usage, water parameters, accumulation of N in the soil and its leaching or deformation that determine the amounts of N-fertilizers to be used **(Hofman and Cleemput, 2004 and Halvarson *et al.,* 2005)**.

Recently, attention was given to use other new technologies of organic manure, which is an output function of aerobic fermentation of cattle dung or other animal wastes as well as plant residues and town refuse, as a partial substitution by chemical or mineral fertilizers. Such organic manure protects the environment from pollution as a result of rationalization of consumption of mineral fertilizers, producing the obtaining a sustainable agriculture as well as clean food. Thus, it is generally believed that combining organic manure with inorganic fertilizers will increase synchrony and reduce losses by converting N-inorganic into organic forms. Some of scientific studies have shown that the N-mineral substitution by N-organic source must be applied as a partial process, where organic manure promoted high levels of nitrate and available C in the soil, enhancing de-nitrification. However, losses were reduced with smaller repeated applications of organic manure. Thus, such studies implying that the use of high quality organic manure as partial substitution for inorganic fertilizer rather than addition to inorganic fertilizer may increase nutrients use efficiency **(Janzen and Schaalje, 1992)**. So that, combined application of inorganic fertilizer and organic manure significantly enhanced available N status over similar N addition through N-inorganic alone. At the same times, other available nutrient contents in the soil increased with successive rise in levels of organic manure addition as compared to the applied N-inorganic alone. This is emphasized by the results outlined by **Abou El-Enein *et al.* (2008)** who pointed out that the nutritional status of soil improved in plots receiving combined application of N-mineral and organic manure.

So that, it could be said that N-organic source should be used to face such a great problem of the excessive N-mineral uses for these hybrid varieties. Hence, applying organic manure leads to alleviate the hazardous effects of environmental pollution risks. In addition, the applied organic manure should be enhance continuous microbial activity that causes a slow release of essential plant nutrients along the growth stages of grown plants, and in turn to minimize their possible losses by either leaching process or volatilization. In this concern, **Hegazi (2004)** reported that organic manures are enrichments in both organic and mineral substances essential to plant growth and activating the bio-chemical processes in plants, *i.e.,* respiration, photosynthesis and chlorophyll content, which increased the yield quality and quantity. Moreover, the positive effects of applied organic substances may be attributed to their causing a lot of effective roles on seed germination, seedling growth, root growth or distribution, shoot development as well as improve many physiological processes in plants under the adveseable soil conditions **(KuliKova *et al*., 2005)**.

The above-mentioned results are also in harmony with many various benefits of the released active organic acids during decayed organic substances, which have been reported to promote an increase nutrient uptake and stimulate plant growth. However, it promotes plant growth by its effects on ion transfer at the root level by activating the oxidation-reduction state of the plant growth medium and so increased absorption of nutrients, especially micronutrients, by preventing precipitation in the nutrient solution. In addition, it enhances cell permeability, which in turn made for a more rapid entry of nutrients into root cells and so resulted in higher uptake of plant nutrients. This effect was associated with the function of hydroxyls and carboxyls in these compounds as well as the principal physiological function of this acid may be that they reduce oxygen deficiency in plants, which results in better uptake nutrients **(Humax, 2006)**.

Also, this approach represents a new strategy in agriculture field that has a long-term positive agronomic value and an effective practice of nutrient management, and in turn affects the country's economy and its development due to the rationalize use of N-mineral fertilizers. Moreover, it is not considered only an ideal solution to meet the excessive nitrogenous fertilizers demand, but also it represents surplus point for sustainable agriculture system. Therefore, the main target of this study was at evaluating the integrated effect of a partial substation of N-mineral by organic N- source derived from poultry wastes soaking solution through a drip irrigation system on the growth parameters of grown tomato plants, fruit yield and quality. Such scientific research represents a trial for explaining the positive effect of applied N-organic source vs the negative effect of the continuous use of N-mineral fertilizers, which cause potential risks to environmental pollution for soil, water and plant that carry an adverseable effect on human health **(Pimentel, 1996)**.

MATERIAS AND METHODS:

A field experiment randomized complete block design, with three replicates was executed on a newly reclaimed sandy soil at a private farm located adjacent to the desert road of Cairo-Asyut El-Gharby, Beni-Suef Governorate, Egypt during two successive seasons of 2009 and 2010. Analytical data of the soil are presented in Table (1), **(Kulte, 1986 and Page et al., 1982)**.

Table (1): Some physico-chemical and fertility characteristics of the studied soil.

Soil characteristics	Value	Soil characteristics.	Value
Particle size distribution %		pH (1:2.5 soil water suspension)	7.95
Sand	90.20	ECe dS m^{-1} (*Soil paste extract*):	3.85
Silt	6.40	*Soluble ions in soil paste extract(m molc L^{-1}):*	
Clay	3.40	Ca^{++}	12.34
Soil texture class	Sandy	Mg^{++}	7.56
Bulk density (Mg m^{-3})	1.57	Na^{+}	18.70
Total porosity %	41.85	K^{+}	0.25
Hydraulic conductivity (cm h^{-1})	6.32	CO_3^{--}	0.00
Available water %	7.20	HCO_3^{-}	1.95
$CaCO_3$ %	2.65	Cl^{-}	21.15
		SO_4^{--}	15.75
Gypsum %	0.42	CEC (C molc kg^{-1} soil)	5.14
Organic matter %	0.17	ESP	5.52

Available macro and micronutrients (mg/kg soil)						
N	P	K	Fe	Mn	Zn	Cu
12.89	3.14	46.35	3.07	0.91	0.73	0.46

Examined treatments were as follows:

a. Control, 100 % of the recommended N-mineral dose in a form of urea (46 N %).
b. 25 % of the recommended N-mineral dose, supplemented with a partial substitution by 75% the applied water soaking solution of poultry wastes.
c. 50 % of the recommended N-mineral dose, supplemented with a partial substitution by 50 % the applied water soaking solution of poultry wastes.
d. 75 % of the recommended N-mineral dose, supplemented with a partial substitution by 25 % the applied water soaking solution of poultry wastes.

The chemical characteristics of poultry wastes in either solid or water soaking solution (1 solid : 3 water) phases were determined according to the standard methods outlined by **Soltanpour and Schwab (1977) and Lindsay and Norvell (1978)**. The obtained data of the studied poultry chemical characteristics are presented in Table (2).

Table (2). Chemical characteristics of poultry wastes either solid or water soaking solution.

Solid phase			
Character	Value	Character	Value
Moisture %	12.72	Total phosphorus %	0.9100
Ash %	18.90	Total potassium %	1.7100
Organic matter %	67.37	Total iron %	0.6591
Organic carbon %	39.17	Total manganese %	0.0972
Total nitrogen %	2.70	Total zinc %	0.0773
C/N ratio	14.51	Total copper %	0.0511

Some chemical character and available nutrient contents (mg kg^{-1})								
EC, dS/m	pH	N	P_2O_5	K_2O	Fe	Mn	Zn	Cu
Solid phase								
2.59*	6.51**	4095.7	746.8	2115.9	983.4	195.6	107.3	97.5
Water soaking solution								
3.42	6.48	1295.4	430.7	784.9	429.1	110.2	92.3	45.8

*Water extract 1:10 **Water suspension 1:10

The applied irrigation water represents a mixture of agricultural drainage water (EC=3.27 dS/m) and Nile fresh water (EC=0.36 dS/m) with a ratio of about 1:1 through a drip irrigation system. The chemical characteristics of the used water sources and their mixture are presented in Table (3).

Table (3). Chemical characteristics of the available water resources.

Water pH	ECiw, dS/m	Soluble ions (mmolc L^{-1})							Adjusted SAR
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3-	Cl^{-}	SO_4^{2-}	
The irrigation Nile water									
7.25	0.35	1.25	0.70	1.40	0.20	1.45	1.30	0.80	2.00
The irrigation mixed water									
7.57	0.0.90	2.72	1.36	4.26	0.50	4.51	3.01	1.32	6.08
The agricultural drainage water									
7.98	2.21	5.21	2.95	12.14	0.95	7.26	10.24	3.75	13.10

On 4 and 10 June for the two successive seasons of 2009 and 2010, respectively, thirty day old seedlings of tomato (*Lycopersicon esculentum*, 1077 El-Basha hybrid cv.), were transplanted to the experimental field. The experimental plot was 480 m^2, each plot was planned to include 20 rows (20 m long and 1.20 m width), and the interplant spacing was 50 cm within each row (about 11000 plants/fed). The irrigation water was added through drip irrigation system, which was applied daily through in-line drippers (two plants/emitter with a discharge of 4 L h^{-1}). The local common cultivation practices were executed.

The water soaking solution of poultry wastes was applied with a mixture of saline irrigation water through a drip irrigation system five times/week at a rate of 5 m^3/fed ≈30 m^3/ week. The recommended doses of different mineral fertilizers were applied through a fertigation system, taking into consideration that tomato seedlings were irrigated during the first week with a mixture of saline water plus phosphoric acid only twice/week for enhance plant roots formation and distribution. After that, the grown plants were fertilized with ammonium sulphate (21.5 % N) as N-source, phosphoric acid as P-source, potassium sulphate as K-source and magnesium sulphate as Mg-S- sources. The experiment was ended at 17 and 25 November for the two successive growing seasons of 2009 and 2010, respectively.

At 60 days after transplanting, eight plants were randomly selected from each plot to determine some growth parameters, *i.e.*, plant height, number of leaves/plant, thickness of shoot/plant at soil surface, number of branches/plant, mean of leaf area and dry weight/plant. The youngest fully expanded leaves were taken from each plot for determining leaf contents of chlorophyll a&b concentration **(Hiscox and Isrealstam, 1979)**, N, P and K in the digested dry matter **(Page *et al.,* 1982)** as well as number of inflorescences/plant and number of flowers/inflorescence. Moreover, soil samples were analyzed for N, P and K **(Page *et al.,* 1982)**. Available micronutrients of Fe, Mn, Zn, and Cu in soil were extracted using ammonium bicarbonate-DTPA extract according to **Soltanpour and Schwab (1977)**, and their contents in soil were measured by using the Atomic Absorption Spectrophotometer.

When tomato fruit reached 'color breaker stage, number of fruits/plant, average of fruit weight, fruit yield/plant and fruit yield/fed as well as fruit contents of citric acid and total soluble solids (TSS) using hand held Brix meter were determined according to the methods undertaken by Association of Official Analytical Chemistry **(A.O.A.C., 1990)**. All data of the two growing seasons were subjected to the statistical analysis according to the used design. The least significant difference test (LSD) at p = 0.05 level was used to verify the differences between treatments as mentioned by **Snedecor and Cochran (1980)**.

RESULTS AND DISCUSSION

I. A general view on both experimental soil and used irrigation water:

The experimental sandy soil represents one of the scattered Private Farms that are mainly encompassing the aoelian deposits that developed on the outskirt desert zone adjacent to the desert road of Cairo-Asyut El-Gharby, Beni-Suef Governorate, Egypt. It is also surveyed as non-saline and non-sodic soil developed under climatic conditions of long hot rainless summer and short mild winter, with scare amounts of rainfall. Due to the prevailing quartz grains, it is not only characterized by siliceous in nature but also poorer in essential plant nutrients and soil moisture content for the grown plants and biological activity, Table (1). According to field studies and analytical data of the experimental soil, it could be classified Typic Torripsamments, siliceous, hyperthermic, deep **(USDA, 2010)**. Also, according to parametric system undertaken by **Sys and Verheye (1978)**, soil limitations for productivity of the irrigated agriculture land are included in soil with an intensity degree of very severe (rating <40), as shown in Table (4). Also, the suitability class for irrigated agriculture land under either current or potential condition could be surveyed as a marginally suitable class ($S3s_1$).

Table (4): Soil limitations and rating indices for the evaluation of the studied soil.

Suitability condition	Topography (t)	Wetness (w)	S				Soil salinity/ Alkalinity (n)	Rating (Ci)	Suitability class	Suitability subclass
			Soil texture (s1)	Soil depth (s2)	$CaCO_3$ (s3)	Gypsum (s4)				
Current	100	100	30	100	100	90	100	27.00	S3	S3s1
Potential	100	100	30	100	100	90	100	27.00	S3	S3s1

Also, the evaluation indices of land characteristics are done by rating them and specifying their limitations for certain crops by matching the calculated rating with the crop requirements in different suitability levels as proposed by **Sys *et al.* (1993)**. In the studied area, without major land improvements, the crop requirements were matched with the present land qualities for processing the current and potential land suitability of the different land units. This approach enables management of different alternatives for specific utilizations that are adapted to the existing limitations to give maximum output. The suitability classes of the experimental soil either in the current or potential condition for the cultivation of tomato plants are shown in Table (5).

Table (5). Soil suitability for cultivation of tomato plants.

Condition	Topography (t)	Wetness (w)	Permanent soil characteristics				Salinity/ alkalinity (n)		Rating (Ci)	Suitability class	Suitability subclass
			Soil texture (s_1)	Soil depth (s_2)	$CaCO_3$ (s_3)	Gypsum (s_4)	ECe	ESP			
Current	100	100	50	100	90	100	70	50	15.75	N1	N1S_1n
Potential	100	100	50	100	90	100	100	100	45.00	S3	S3s_1

As for this purpose, the land utilization is applicable for the main characteristics of the studied area, which are considered regarding land qualities of drainage, salinity and sodicity. Moreover, the resultant adaptations of soil suitability class for cultivating tomato plants could be considered as a not suitable (N1S_1n) and marginally (S3s_1) adaptation in the current and potential conditions, with a rating index of 15.75 and 45.00 %, respectively. Also, soil texture (s_1), calcium carbonate (s_3), salinity (ECe) and alkalinity (ESP) represents the main limitation for soil productivity. As for the potential condition soil salinity and alkalinity should be corrected, but soil texture (s_1) and calcium carbonate (s_3) will be remained as permanent soil limitations.

The available irrigation water sources are included the fresh Nile water, saline agricultural drainage water and a mixture of them. According to **Ayers and Westcot (1985)** scale, the used irrigation Nile water belongs to the first class (C1S1, ECiw < 0.75 dS/m and SAR < 6.0), which denoted no problems are expected for soil salinity and sodicity. On the other hand, the agricultural drainage water lies within both the third and second categories for salinity and sodicity levels (C3S3, ECiw > 3.0 dS/m and SAR > 9.0) that denote severe and increase problems are expected for soil salinity and sodicity, respectively. The mixed water lies in between (C2S1), where the ECiw = 0.75-3.00 dS/m and SAR < 6.0, that denote an increase problem for soil salinity and no problems for soil sodicity are expected.

II. Soil properties as affected by applied water soaking extract of poultry wastes manure:

Data presented in Table (6) showed the beneficial effects of applied water soaking solution of poultry wastes on soil properties vs the used saline irrigation water for irrigation, whether the obtained values tended to be increased or decreased as compared with the initial soil data (Table, 1). It is clearly that application of water soaking solution of poultry wastes was positively reflected on the different physical, chemical and fertility properties of the soil under investigation, This was emphasized by a marked decrease of the ECe and ESP values (as an average of the two seasons) in the root zone of the treated soil with water soaking solution of poultry wastes. At the treatment of (25% N-mineral + poultry wastes soaking solution) both properties reached 33.79 and 31.87 % as compared to the control treatment of (100% N-mineral fertilizer), respectively. Under such actual favourable conditions of soil salinity and sodicity, the associated soil physical (*i.e.,* bulk density, total porosity, available water range and hydraulic conductivity), chemical (*i.e.,* organic matter, pH, CEC, ECe and ESP) and fertility properties (*i.e.,* available macro and micronutrient contents) properties could be improved, as shown in Table (6).

Table (6): Some soil properties as affected by water soaking solution of poultry wastes during the summer seasons of 2009 and 2010.

Soil properties	Growing season	Applied treatment (T)				L.S.D. at 5 % (T)
		100% N-mineral fertilizer	75% N-mineral + poultry soaking	50% N-mineral + poultry soaking	25% N-mineral + poultry soaking	
Bulk density (g/cm^3)	2009	1.59	1.52	1.46	1.40	0.12
	2010	1.58	1.50	1.45	1.39	0.10
Total porosity %:	2009	40.00	42.64	44.90	47.17	2.76
	2010	40.37	43.40	45.28	47.55	2.40
Available water %	2009	7.17	7.94	8.65	9.82	0.57
	2010	7.28	8.09	8.90	10.02	0.48
Hydraulic conduct. (cm/h)	2009	6.36	5.03	4.75	3.94	0.75
	2010	6.15	4.98	4.57	3.48	0.52
Organic matter %	2009	0.18	0.27	0.34	0.45	0.10
	2010	0.20	0.31	0.35	0.46	0.07
pH (1:2.5 water suspension)	2009	7.97	7.63	7.58	7.50	0.12
	2010	7.89	7.60	7.55	7.46	0.09
CEC (C molc kg^{-1} soil)	2009	5.20	5.98	6.53	7.35	1.25
	2010	5.25	6.07	6.67	7.75	1.05
ECe (dS/m)	2009	3.74	3.10	2.85	2.52	0.35
	2010	3.60	2.95	2.60	2.35	0.22
ESP%	2009	5.50	4.90	4.45	3.90	1.08
	2010	5.42	4.69	4.08	3.54	0.95
Macro and micronutrients (mg/kg soil)						
N	2009	43.35	39.78	40.97	41.56	0.58
	2010	44.01	40.24	41.12	42.12	0.47
P	2009	3.20	4.55	5.09	5.87	0.35
	2010	3.25	4.67	5.45	6.04	0.21
K	2009	47.45	55.70	63.35	70.48	2.36
	2010	48.91	56.95	65.48	71.35	1.78
Fe	2009	3.15	3.97	5.04	5.73	0.20
	2010	3.22	4.02	5.18	5.95	0.14
Mn	2009	0.92	1.05	1.20	1.45	0.09
	2010	0.95	1.12	1.32	1.57	0.06
Zn	2009	0.74	0.95	1.18	1.35	0.47
	2010	0.78	1.07	1.25	1.42	0.35
Cu	2009	0.49	0.75	1.04	1.16	0.55
	2010	0.52	0.89	1.17	1.25	0.43

a. Soil physical properties:

Concerning the variations in soil bulk density, data show that a gradually decrease in its values was occurred with increasing the applied ratios of poultry wastes soaking solution, where the greatest ratio gave the lowest soil bulk density value of 1.395 Mg m^{-3} (as an average of the two seasons). This positive effect might attribute to the pronounced content of organic colloidal particles (active organic acids), which plays an important role for modifying distribution pattern of pore spaces in soil. These findings are in agreement with those obtained by **Batey (1990)** who reported that soil bulk density was closely related to solid phase properties and pore spaces. This beneficial effect positively reflected on increasing soil total porosity. At the same time, the amended saline irrigation water with poultry soaking solution encouraging or creating capillary or micro pores (*i.e.,* water holding and useful pores) as well as such organic substances have high ability to retain a pronounced content of water, which in turn increasing capillary potential of water and the available water range. These findings are confirmed by **Askar *et al.* (1994)** who found that the addition of organic materials to soil greatly increased the water holding pores and decreased the area between the boundary lines (drying and wetting curve) of the hysteresis loops. Also, a gradual decrease in the hydraulic conductivity value was parallel with increasing the applied poultry soaking solution in irrigation water this may be due to the released active organic acids which tend to occupy the larger pores and encourage the creation of medium and micro pores between the simple packing sand particles. Consequently, inhibits the rapid velocity of down-movement of water in saturated condition.

b. Soil chemical properties:

Data in Table (6) also showed that applying poultry wastes soaking solution in combination with saline water regardless the absolute changes in some soil chemical properties, *i.e*., pH, organic matter content and CEC were noticeable, however, soil ECe, ESP and pH values tended to decrease with increasing the applied ratios of poultry soaking solution vs an increase for each of soil organic mater content and CEC. This was true, since the accumulation of such active organic substances in soil leads to reduce soil pH vs an increase in soil organic component, besides the cation exchange capacity of these organic materials is very high (200 to 500 C molc kg^{-1} at pH 7), and in turn positively reflected on soil CEC. It is worthy to mention the effective role of applied organic substances in poultry wastes soaking solution on reducing soil salinity/alkalinity, probably due to the occurrence of the charged sites (*i.e*., COO-) accounts for the ability of organic active acid to chelate and retain cation in non-active forms **(Jackson, 2006)**.

c. Soil available macro and micronutrient contents:

The available nutrient levels in the initial state of the experimental soil, Table (7) showed that the studied nutrients (N, P, K, Fe, Mn, Zn and Cu) lay within the low to medium of nutrient critical limits undertaken by **Lindsay and Norvell (1978) and Page *et al.* (1982)**.

Table (7): Critical limits of the available nutrients contents in the soil.

Nutrients **(mg kg^{-1} soil)**							
Limits	N	P	K	Fe	Mn	Zn	Cu
Low	< 40.0	< 5.0	< 85.0	< 4.0	< 2.0	< 1.0	< 0.5
Medium	40.0-80.0	5.0-10.0	85.0-170.0	4.0-6.0	2.0-5.0	1.0-2.0	0.5-1.0
High	> 80.0	> 10.0	> 170	> 6.0	> 5.0	> 2.0	> 1.0

That is true, since the experimental soil is not only poor in the nutrient-bearing minerals, but also in organic matter content, which are considered as storehouse for the essential plant nutrients. On the other hand, data illustrated in Table (6) indicated that the available contents of the studied macro- (N, P and K) and micronutrients (Fe, Mn, Zn and Cu) in soils irrigated with the amended saline water with poultry wastes soaking solution, that is enriched with active organic substances and available nutrients, were drastically positive affected by increasing the applied ratios of poultry wastes soaking solution. These findings are in harmony with those outlined by **Humax (2006)** who pointed out that humic acid has a high complexation ability with ions in the environment due to the high carbon content (60 %) of both aliphatic and aromatic character and the richness in oxygen-containing functional groups such as carboxyl, phenolic, alcoholic and quinoid groups, which is beneficial for plant nutrition.

In general, the relative increase in available nutrient contents may be due to modifying suitable air-moisture regime that positively affected biological activity and the supply of available nutrients as well as alleviating the depressive effect of water salinity stress on the released nutrient from either organic residues or nutrient bearing minerals. Moreover, the applied poultry wastes soaking solution its self is considered as a chelated agent for some macro and micronutrients. It was also observed that the applied organic substances attach the nutrients as easily soluble ones and retained at a shallow depth (within the surface 30 cm depth) under drip irrigation system, and consequently enhancing their mobility and uptake by plant roots. **Alva and Mozzafari (1995)** confirmed these findings as they reported that using drip irrigation method maintained high concentrations of nutrients at shallow depth of soil. In contrast, the applied organic substances are mainly soluble in water and make available to plants certain nutrients that would be unavailable otherwise. Also, these organic substances also allow the reduced supply of water in its very thin film to be more easily released during drought conditions, and thus are made available to the roots of the plants. In addition, such organic substances help water penetrate and permeate plant cells, assisting nutrient uptake and water storage during drought conditions. These organic substances may balance water during drought conditions and assist plant transpiration, the transport of water and nutrients of the cell tissues as well as assist in the accumulation of soluble sugars which helping to prevent wilting **(Jackson, 2006)**.

III. Influence of amended saline water with poultry soaking solution on plant parameters:

a. Vegetative growth characters:

Since vegetative growth characters represent a part of the total biological yield of any crop, hence favourable conditions for their adapted play an important role determinant the economic yield. Data of the studied vegetative growth characters of tomato plants (*i.e.*, plant height, number of leaves/plant, thickness of shoot/plant at soil surface, number of branches/plant, mean of leaf area and dry weight/plant) that irrigated with amended saline water with poultry wastes soaking solution ratios through drip irrigation system showed significant increases, as shown in Table (8). That was true, since the applied organic substance in poultry wastes soaking solution leads to alleviate the hazardous effect of salinity/alkalinity stress, probably due to the occurrence of the charged sites (*i.e.*, COO-) accounts for the ability of organic active acid to chelate and retain cation in non-active forms **(Jackson, 2006)**. These results are in harmony with those reported by **Gupta and Gupta (1984)** who found that salinity stress negatively affected plant growth through the influence of several factors on physiological processes, *i.e.*, photosynthesis, osmotic potential, specific ion effect and ion uptake. The previously behaviour could be primarily due to an adjustment of subcelluler ion distribution to maintain osmotic potentials and favourable water relations **(Treeby and Van-Steninck, 1988)**.

It is evidently that impact of the applied poultry wastes soaking solution the dry matter productions was more attributed to the leaves area and number, may be due to the obtained increases in the dry matter accumulations can be interpreted on the fact that higher leaves area and number contributed to more photosynthesis and better carbohydrates yield. These findings are in harmony with those obtained by **Duncan (1971)** who obviously cleared the importance of canopy structure in light interception, vegetative growth and yield. Also, higher values of such plant parameters were more related to drip irrigation system, which represents an efficient irrigation procedure than furrow irrigation, this finding is in agreement with it has been reported by **Chawla and Narda (2000)**.

Table (8): Some growth parameters of tomato plants as affected by water soaking solution of poultry wastes during the summer seasons of 2009 and 2010.

Tomato growth characters	Growing season	Applied treatment (T)				L.S.D. at 5 % (T)
		100% N-mineral fertilizer	75% N-mineral + poultry soaking	50% N-mineral + poultry soaking	25% N-mineral + poultry soaking	
Plant height (cm)	2009	57.26	70.93	80.78	84.54	8.18
	2010	59.54	73.98	84.02	87.43	7.75
No. of leaves/ plant	2009	71.37	80.17	86.88	89.92	5.48
	2010	74.25	83.65	88.30	91.23	6.85
Thickness of stem (cm)	2009	1.23	1.53	1.71	1.84	0.17
	2010	1.28	1.59	1.78	1.89	0.19
No. of branches/plant	2009	10.42	13.63	15.37	15.70	2.10
	2010	10.83	14.22	15.98	16.26	2.14
Mean of leaf area (cm^2)	2009	40.64	53.58	61.58	64.42	7.96
	2010	42.27	55.72	64.04	66.90	8.22
Dry weight/ plant (g)	2009	63.91	80.43	92.88	97.20	6.48
	2010	66.48	83.90	96.58	101.04	6.57

Moreover, application of poultry wastes soaking solution, that is enriched with soluble active organic substances and essential plant nutrients, to tomato plants through drip irrigation system increased the availability and uptake of nutrients, and consequently promotes plant growth and the dry matter yield. The mechanism of applied active organic substances on stimulating growth is similar to plant growth regulators. In addition, such organic substances include auxins or function as auxins and thus affect plant metabolism in a positive manner. Gibberellins are natural plant hormones that regulate the balance in plant development, affecting cell division, stem elongation and the triggering of DNA gene codes of enzymes that break down starches and awaken plant seeds and buds. Cytokinins are active in plant cell division and help prevent leaf aging while working with auxins to control the growth and development of plants in general. However, such organic compounds cause specific enzyme action, which stimulates DNA and RNA activation and cellular growth.

b. Leaf contents of chlorophyll a&b, some nutrient and flower characters:

Data presented in Table (9) indicate an achieved favourable condition for chlorophyll a&b concentration in plants irrigated with saline water amended with poultry wastes soaking solution added through drip irrigation system. This is testimony for the longer source activity in such efficient irrigation system, where soluble active organic substance levels were applied through many split doses to match the nutrients uptake by crop. This enhanced the current photosynthesis for developing vegetative growth parameters that leading to the development of dry matter production per plant in the case of amended saline irrigation water. These findings are in harmony with results obtained by **(Hebbar *et al*., 2004)**.

Also, it can be explained on the basis that irrigated soil with amended saline water became enriched in the released nutrient contents, especially those of micronutrients, which are involved directly or indirectly in formation of biological components through their roles in the respiratory and photosynthesis mechanisms as well as in the activity of various enzymes **(Nassar *et al.,* 2002)**. In this connection, **Abdel-Aziz and El-Shafie (2005)** reported that the increase of chlorophyll a&b concentration is owing to that the enhanced nutrients uptake plays an important role for stimulating chlorophyll synthesis enzymes, which reflected on formation of chlorophyll molecules. Thus, the promotive effect of the applied treatments on leaf chemical constituents might be attributed to their enhancing effect on the nutritional status of tomato plants, and then the increase in dry weight of plant that could be attributed to its stimulating effect on vegetative growth and physiological processes, *i.e.,* increasing number of cells through cell division and meristematic activity of tissues.

Table (9): Some tomato leaf and flowering characters as affected by water soaking solution of poultry wastes during the summer seasons of 2009 and 2010.

Tomato leaf and flowering characters		Growing season	Applied treatment (T)				L.S.D. at 5 % (T)
			100% N-mineral fertilizer	75% N-mineral + poultry soaking	50% N-mineral + poultry soaking	25% N-mineral + poultry soaking	
Leaf contents of chlorophyll (a&b)*		2009	1.82	1.89	2.61	2.75	0.19
		2010	1.89	2.20	2.72	2.84	0.21
Leaf contents %	N	2009	3.38	1.99	2.79	3.27	0.21
		2010	3.49	2.07	2.91	3.40	0.22
	P	2009	0.29	0.35	0.41	0.43	0.04
		2010	0.31	0.36	0.42	0.44	0.05
	K	2009	1.83	2.12	2.29	2.38	0.22
		2010	1.90	2.21	2.39	2.48	0.23
No. of inflorescences/plant		2009	25.16	31.48	36.52	38.13	3.27
		2010	26.27	32.85	38.00	39.45	3.73
No. of flowers/plant		2009	3.92	4.98	5.60	5.83	0.31
		2010	4.08	5.20	5.83	6.07	0.40

*mg/g fresh weight

The ability of active organic substances in the applied poultry wastes soaking solution for increasing plant nutrient uptake is due to its chelating property, which makes the nutrients more available to plants as well as owing to its ability to enhance cell permeability that making a more rapid entry of nutrients into plant cells. Such active organic substances can also reduce the surface tension of water and increase the effectiveness of nutrients or chemicals. In addition, using drip irrigation with active organic substances and attached nutrients had a significantly higher N, P and K contents and uptake by tomato plants over that irrigated with saline water (Table, 7). These increases in N, P and K uptake were due to the frequent application of these nutrients in better availability in root zone coupled with better root activity. Further, it was also due to the reduced loss of these nutrients, particularly under such skeletal soil as compared to furrow irrigation. Similar observations reported by **Van Sane *et al.* (1996).** This means that the applied poultry wastes soaking solution through drip irrigation system plays an important role for increasing the supplying power of soil capacity against nutrient loss and deficiency. Also, this benefit was positively reflected on the vegetative growth and plant contents of N, P and K. These findings are also in agreement with those obtained by **Habashy (2005)** who reported that fertigation system increased N, P and K contents in plant tissues of tomato.

These favourable conditions are also positively reflected on the number of both inflorescences and flowers/plant, which are more attributed to many various benefits of applied active organic substances in the applied poultry wastes soaking solution. Also, these benefits are more related to promote an increase nutrient uptake and stimulate plant growth. However, it promotes plant growth by its effects on ion transfer at the root level by activating the oxidation-reduction state of the plant growth medium and so increased absorption of nutrients, especially micronutrients, by preventing precipitation in the nutrient solution. In addition, it enhances cell permeability, which in turn made for a more rapid entry of nutrients into root cells and so resulted in higher uptake of plant nutrients. This effect was associated with the function of hydroxyls and carboxyls in these compounds. The principal physiological function of humic acid may be that they reduce oxygen deficiency in plants, which results in better uptake nutrients **(Humax, 2006)**.

c. Tomato fruit yield and some fruit characters:

Undoubtedly saline stress, as resulted from irrigation water, is one of the most serious problems faced the agriculture development. However, salinity of irrigation water and soil nutrient deficiencies herein represent the main factors controlling the reduction of the crop yield, particularly under the prevailing arid conditions. In addition, irrigation water salinity may be considered not only diminishing the absorbed nutrients but also possibly playing an important role in damaging the translocation vascular system in higher plants **(Shukla and Mukhi, 1985)**. The obtained data in Table (10) indicate that poultry wastes soaking solution added as mixed with saline irrigation water through a drip irrigation system registered a pronounced tomato yield with high fruit quality as compared to those irrigated with the saline irrigation water under the same irrigation system. Such relative increases could be attributed to significantly higher increments in dry weights and number of flowers per plant, which positively reflected on the higher number of tomato fruit and yield per plant and fed. Moreover, this distinctive tomato yield advantage reflected under these prevailing conditions is further amplified by such drip system, which leads to maintenance of favorable available soil moisture and nutrients contents in the root zone. These results are in harmony with **Phene and Beale (1976)** who mentioned that drip irrigation system with N, P and K added as soil application helped the plants to utilize moisture as well as nutrients more efficiently for the limited wetted area.

Table (10): Tomato fruit yield/fed and some fruit characters as affected by water soaking solution of poultry wastes during the summer seasons of 2009 and 2010.

Tomato fruit characters at harvest stage		Growing season	Applied treatment (T)				L.S.D. at 5 % (T)
			100% N-mineral fertilizer	75% N-mineral + poultry soaking	50% N-mineral + poultry soaking	25% N-mineral + poultry soaking	
Average of fruit weight (g)		2009	89.33	119.03	145.91	152.75	6.97
		2010	92.90	124.20	151.77	158.55	7.23
No. of fruits/plant		2009	26.76	32.09	37.19	38.58	3.42
		2010	27.83	33.37	38.67	40.10	3.55
Fruit yield/plant (kg)		2009	2.37	3.77	5.40	5.72	0.35
		2010	2.59	4.13	5.87	6.26	0.40
Fruit yield (ton/fed)		2009	11.91	18.97	27.04	29.10	1.80
		2010	12.95	20.66	29.33	31.64	1.92
Fruit contents %	Citric acid	2009	0.43	0.55	0.58	0.61	0.03
		2010	0.44	0.58	0.60	0.63	0.04
	TSS	2009	4.42	4.55	4.65	4.78	0.13
		2010	4.50	4.62	4.67	4.80	0.15

Tomato fruit quality can be evaluated by different parameters, *i.e*. number of fruits/plant, average weight of fruit, fruit yield/plant, fruit yield/fed., fruit content of citric acid and total soluble solids (TSS), as shown in Table (10). The obtained results showed significant differences in all the above-mentioned parameters as affected by amended saline irrigation water with poultry wastes soaking solution as compared to the effect of used saline water solely. It is noticed that usage of amended saline irrigation through a drip irrigation system had a positive impact on the studied parameters of fruit quality this may be due such active organic substances control many stress adaptation responses including stomatal closure, osmotic adjustment, ion compartimentation, regulation of shoot versus root growth and modifications of root systems **(Maggio *et al*., 2006)**. These results are in harmony with the findings outlined by **Abou Zied *et al.* (2005)** who found that using some organic polymers and humic acid improve the productivity and quality of some crops grown on a sandy soil.

Finally, it is evident from the abovementioned results that application of organic substances such as poultry wastes soaking solution achieves many of the beneficial effects on soil physic – bio-chemical properties and fertility status as well as grown plant parameters, since such active organic substances are partially capable to retain water and nutrients in soil for grown plants as well as acts like plant growth hormones. In general, mixing poultry wastes soaking solution with saline irrigation water through a drip irrigation system was more effective on ameliorating soil and plant characters due to the continuous supplementary among the different growth stages of plant. In addition, it could be interpreted these beneficial reacts to a fact of such organic substances would act as chelating agent, through OH and COOH as active groups for micronutrients and water molecules, which minimizes nutrients loss by leaching. Moreover, such organic substances are considered as a storehouse for easily mobile or available nutrients to uptake by plant roots, and in turn reflected positively on development of crop yield and its attributes. That means, if suitable management practices were adapted, it was feasible to irrigate tomato using amended saline irrigation water under arid conditions of Egypt.

REFERENCES

Abdel Aziz, El-Set. and A.I. El-Shafie (2005). Response of soybean to foliar application of phosphatic fertilizer and some micronutrients. Egypt J. Appl. Sci., 20 (5B): 696-719

Abou El-Enein, S.M.; T.M. Mosalem; S.A.A. Raies and M.H. Abdel All (2008). Effect of composted plant residues on the available of some nutrients in newly reclaimed soils. Egypt. J. Soil Sci., 48 (3): 293-304.

Abou Zied, M.M.A.; N.R. Habashy and A.A.A. Wahdan (2005). Utilization of some organic polymers and humic acids for improving a sandy soil productivity of peanut and their residual effects on the next crop of faba bean. Fayoum J. Agric. Res. & Dev., 19 (2): 42-55.

Alva, A.k., and M. Mozzafari (1995). Nitrate leaching in deep sandy soils as influenced by dry broadcast of fertigation of nitrogen for citrus production. In International Symposium On Fertigation Technology, Israel, 26-31 march 1995, pp. 67-77.

Askar, F.A.; S. Marei, and H. El-Zaher (1994). Sewage sludge as natural conditioner for newly reclaimed soils. 1: Effect on soil moisture retention characteristics and pore size distribution. Egypt J. Soil Sci., 34: 67.

Association of Official Analytical Chemistry (1990). Official Methods of Analysis 15 th ed., AOAC, Washington DC., USA.

Ayers, R.S. and D.W. Westcot (1985). Water quality for agriculture, irrigation and drainage. Paper No. 29, FAO, Rome, Italy.

Batey, T. (1990). Control of compaction on the farm; A personal view. Soil Technology, 3: 225-229.

Chawla, J.K. and N.K. Narda (2000). Growth parameters of trickle fertigated potato. Indian J. Agric. Sci., 70 (11): 747-752.

Duncan, W.G. (1971). Leaf angle, leaf area and canopy photosynthesis. Crop. Sci., 11: 482-485.

Gallardo, A.H.; W.R. Borja and N. Tase (2005). Flow and pattern of nitrate pollution in ground water: A case study of an agricultural area in Tsukuba City, Japan. Environmental Geology, 48: 908-919.

Gupta, V.K. and S.P. Gupta (1984). Effect of Zn sources and levels on growth and Zn nutrition of soybean (*Glycine max.*) in the presence of Cl and SO_4 salinity. Plant and Soil, 81: 299-304.

Habashy, N.R. (2005). A comparative study for phosphorus forms or applied methods and their effects on tomato fruit yield and its quality in a calcareous soil. Egypt. J. Appl. Sci., 20 (8A): 290-304.

Halvorson, A.D.; F.C. Schweissing; M. E. bartolo and C.A. Reule (2005). Corn response to nitrogen fertilization in a soil with high residual nitrogen. Agron. J., 97:1222-1229.

Hebbar, S.S.; B.K. Ramachandrappa; H.V. Nanjappa and M. Prabhakar (2004). Studies on NPK drip fertigation in field grown tomato (*Lycopersicon esculentum* Mill.). Europ. J. Agron., 21: 117-127.

Hegazi, I.M.A. (2004). Maximizing wheat production in sandy soil by using some natural soil amendments. Egypt. J. Appl. Sci., 19 (4): 214-226.

Hiscox, J.D. and G.F. Isrealstam (1979). A method for the extraction of chlorophyll from leaf tissues without maceration. Can. J. Bot., 57: 1332-1334.

Hofman, G. and O. Cleemput (2004). Soil and Plant Nitrogen. International Fertilizer Industry Association, Paris, France.

Humax (2006). Role humic acid increasing plant growth. *htt://www.jhbiotech.com/info/humax info.htm.*

Jackson, W.R. (2006). Role humic acid increasing plant growth: Dynamic growing with humic acids for master gardeners. *htt:/www.soilrenu.com/humic acid.htm.*

Janzen, H.H. and G.B. Schaalje (1992). Barley response to nitrogen, non nutritional benefits of legume green manure. Plant and Soil, 142: 19-30.

Kulikova, N.A.; E.V. Stepanova and O.V. Koroleva(2005). Mitigating activity of humic substances: Direct Influence on Biota. In: Use of Humic Substances to Remediate Polluted Environments: From Theory to Practice, NATO Science Series IV: Earth and Environmental Series, Perminova, I.V. (Eds.). Kluwer Academic Publishers, USA., ISBN: 978-1402032509, 285-309 pp.

Lindsay, W.L. and W.A. Norvell, (1978). Development of DTPA soil test for Zn, Fe, Mn and Cu. Soil Sci. Soc. Am. J., 42, pp. 421.

Maggio, A. ; G. Raimondi ; A. Martino and S. De Pascale (2006). Salt stress response in tomato beyond the salinity tolerance threshold. Dept. of Agric. Engineering and Agronomy, Naples Federico II Univ., Italy.

Marilla, Y.A.; I. El-Nahal and M.R. Agha (2004). Seasonal variations and mechanisms of ground water nitrate pollution in the Gaza Strip. Environmental Geology, 47:84-90.

Nassar, K.E.; A.O. Osman; M.H. El-Kholy; M. Madiha and N. Badran (2002). Effect of seed coating with some micronutrients on faba bean (Vicia faba L.).ll. Effect on yield attributes and mineral composition. Egypt. J. Soil Sci., 42 (3): 363.

Page, A.I. ;R.H. Miller and D.R. Keeney Eds. (1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. 2 nd Edition, Amer. Soc. of Agron., Madison, Wiscosin, U.S.A.

Phene, C.J. and Beale, D.W. (1976): High-frequency irrigation for water nutrient management in humid regions. Soil Sci. Soc. Am. J. 40, 430-436.

Pimentel, D. (1996). Green revolution and chemical hazards. Sci Total Environ., 188: 86-98.

Shukla, U.C. and A.K. Mukhi (1985). Ameliorative role of Zn on maize (*Zea mays* L.) growth under salt-affected soil conditions. Plant and Soil, 87: 423-432.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods. 7th Ed., Iowa State Univ. Press, Ames, Iowa, USA.

Soltanpour, P.N. and A.B. Schwab (1977). A new soil test for simultaneous extraction of macronutrients in alkaline soils. Comm. Soil Sc. and Plant Annal., 8: 195.

Sys, C. and W. Verheye (1978). An attempt to the evaluation of physical land characteristics for irrigation to the FAO framework for land evaluation. Int. 1, Trai. Cent. Post Grad. Soil Sci., Ghent, Belgium.

Sys, C.; E. Van Ranst; J. Debaveye and F. Beernaert (1993). Land evaluation. Part III., Crop Requirements Agricultural Publication No.7, General Administration for Development Cooperation, Ghent, Belgium.

Treeby, M.T. and R.F.M. Van-Steninck (1988). The influence of salinity on P uptake and distribution in lupine roots. Physio. Plant, 72: 617-622.

USDA (2010). Key to Soil Taxonomy. 11th Ed., United States Department of Agriculture, USA.

Van Sane, S.R.; P.G. Bhoi; A.S. Patil and A.D. Tumbare (1996). Effect of liquid fertilizer through drip irrigation on yield and NPK uptake of tomato. J. Maharashtra Agric. Univ., 21 (3): 488-489.