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Agro-Economic Assessment of Added Fertilizers to Tomato Yield Grown at Fayoum Governorate, Egypt

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ABSTRACT

In the recent years the cultivated land of tomatoes and their production in Egypt have been diminished for some reasons; among them fertilization. The current study was performed to assess the effects of applied fertilizers to tomato grown at Fayoum Governorate Egypt (29° 18' 30"N; 30° 50' 39"E) on yield, nutrients uptake, nitrate accumulation, soil fertility, and the relationships among them. Eighteen tomato fields were chosen at four villages in two districts at autumn season of 2016-2017. Representative samples of soil, plant and irrigation water were taken from every site to be analyzed. Furthermore, 120 questionnaires forms were collected from tomato farmers in the studied districts. Results indicated that soils under study were high in nitrogen and most of micronutrients, low in phosphorus and moderately to low in potassium. Irrigation water quality ranged from low to moderately. The total productivity of tomato ranged from 19.350 to 46.548 t. fed^{-1} with an average of 31.096t., where the added fertilizers ranged from 147-259 kg N fed^{-1}, 22.5-75 kg P_2O_5 and 0-96 kg K_2O. Tomato yield significantly correlated with applied fertilizers of N, P and K, but insignificantly correlated with organic manure. The accumulation of nitrate in fruits significantly correlated with uptake of nitrogen, nevertheless the correlation between the applied of nitrogen and the uptake was insignificant. The obtained data of questionnaires forms cleared up that correlation between tomato productivity and the added nitrogen and organic manure was insignificant. Therefore, great attention should be paid to phosphorus and potassium fertilization without excessive addition of nitrogen.

Keywords: fertilizers, tomato yield, soil fertility, water quality and correlations among them.

INTRODUCTION

Tomato (*Lycopersicon esculentum*, Mill.) is one of the most important vegetable crops in Egypt and the world. Egypt ranks as one of the top tomato producers (8,625,219 ton a year); whereas China is the world's top followed by Egypt, India, Turkey and Nigeria. Tomato is cultivated in Egypt at large areas for many seasons through year for local consumption, exportation and processing. Moreover, the total cultivated area was about 490260 feddans at 2012; the local consumption was about 6.07 million ton a year, with an average of 75.5 kg per person a year (FAO, 2012).

Additionally, tomato is considered one of the most important sources of national agricultural income, which occupies an important position in export to attract foreign exchange to the Egyptian economy. The production of tomato reached 8.19 billion L.E., representing about 46.2% of the total income from vegetable production, which was about 17.73 billion L.E. as an average of the period of 2009-2016. Furthermore, the amount of tomato exports reached about 2947 thousand tons representing about 5.3% of the quantity of exports of Egyptian vegetables, which amounted about 55552 thousand tons (MALR 2009-2016).

Nowadays, there are some of the problems that face tomato production in Egypt, which are associated with diseases and insecticides, fertilizers, raising the costs of production, low experience and the role of guidance, marketing and etc. Therefore, in the recent years, the cultivated land of tomatoes and their production have been diminished. Fayoum as one of Egyptian Governorates that famous for cultivating tomatoes, the cultivated area has decreased from 12, 34 to about 2, 86 thousand feddans at the autumn season. In addition, the average production has decreased from 14.8 to 14.6 ton per feddan in the period from 2015-2016. In the winter season, the cultivated area declined from about 13, 13 to 8, 07 thousand feddans, and the average production declined from about 15.26 to 15.21 tons per feddan. On contrast, the cultivated area in the summer season increased from about 2, 78 to 3, 455 thousand feddans, and the average of production increased from about 13.55 to 13.68 tons per feddan (MALR, 2016).

Tomato is one of crops that significantly respond to fertilizers and require high demand of nutrients. Studies reported that total tomato yield and the uptake of NP significantly increased with increasing nitrogen fertilizer up to the rate of 150 kg N fed^{-1}; whereas with continuous application of N up to the rate of 200 kg N fed^{-1} plants produce the highest values of plant growth characters and nitrate concentrations in leaves and fruits (Ahmed and Morsy 2005 and Abdelhady *et al.*, 2017). In newly reclaimed soils, El-Dsuki (1996) showed that the suitable fertilization for tomato yield is to apply 18-20 m^3 fed^{-1} farmyard manure as pre-transplanting and then 130 - 150 kg N fed^{-1} through drip irrigation system as ammonium nitrate; 60 kg P_2O_5 and 144 kg K_2O. Furthermore, the recommendation of Egyptian ministry of Agriculture and Land Reclamation for tomato production is 120-150 kg N, 60 kg P_2O_5 and 100 kg K_2O per fed.

Potassium is the next mineral nutrient to nitrogen, which required at the largest amount by plants (Mengel and Kirkby, 2001). Tomato as a one of crops that require high demand of K for optimal plant growth that ranges of 2-5% of the plant dry weight. Zayton *et al.,* (2009) stated that K fertilizer at the rate of 80-120 kg K_2O fed^{-1} enhanced the tomato plant growth parameters, total and marketable yield and water consumptive use of plants grown under moderate salinity level of irrigation water (2.5 dSm^{-1}). El-Nemr *et al.,* (2012) found that total yield of tomato fruits that grown in sandy culture was significantly influenced by increasing K levels on the nutrient solution up to the high level (350 mg kg^{-1}). Also, phosphorus is considered a key element in several physiological and biochemical processes as well as it achieves a high yield through addition to soil; the balanced supply of nutrients is important to achieve the optimum yield and fruit quality (Abd-El-Hamied and Abd El-Hady 2018).

Accumulation of nitrate in the edible tissues is one of problems that may arise from the excessive use of N-fertilizer. Studies stated that increasing the accumulation of nitrate in fruits had a bad effect on its quality and are dangerous on the common health (Siviero *et al.*, 2001; Hossam 2002; Wong and Li 2004 and Srinivasn 2010). Leaching of nitrate to groundwater may increase its content in drinking water, and lead to higher accumulations in plant tissue. The consumption of excessive nitrate in drinking water and food may cause methemoglobinemia; infants under 6 months of age are particularly susceptible carcinogenic effect of nitrosamines from N is a major human health concern (WHO, 1978 and Lambers *et al.*, 2000). Ammonia volatilization may occur from manure heaps and from soil after manure application. Ammonia also can be volatilized if urea fertilizer is applied to high pH soils under hot and dry conditions (Srinivasn 2010). Accordingly, the excessive application of mineral nitrogen fertilizers may negatively affect yield and its quality, environment and economical return.

Application of organic fertilizers is very important for providing the plants with their nutritional requirements without having any undesirable impacts on the environment (Patil *et al.* 2004, Bayoumi 2005, Fawzy *et al.*, 2007, and Dawa *et al.* 2013). Inoculation of tomato seedlings twice with biofertilizer "microbein" with nitrogen fertilizer at the rate of 100-120 Kg N/fed combined with compost at the rate of 8 t./fed recorded the highest values of total fruit yield of tomato grown in clayey loam to sandy soils (El-Tohamy *et al.* 2009, Ahmed *et al.* 2013 and Mesallam *et al.* 2017).

The objectives of this study were to assess the effects of added fertilizers to tomato grown at Fayoum Governorate Egypt on yield, nutrients uptake, nitrate accumulation in fruits and the relationships between soil fertility, the amounts of added fertilizers and plant production, as well as evaluation irrigation water quality.

MATERIALS AND METHODS

Description of the studied areas:

The study was preformed in Fayoum Governorate, Egypt that lies in the Western South of Cairo Governorate in the Middle of the Western desert (29° 18' 30''N; 30° 50' 39''E). Eighteen tomato fields were chosen at four villages in two districts; El-Rowdah and El-Mazatly of Tamiya District and Mansheyet Abd Elmaged and Mansheyet Elamir of Etsa District; representing the total cultivated area at autumn season of 2016-2017. Nine locations of tomato fields were investigated in every District. El-Rowdah and Mansheyet Elamir villages had five locations for every village, and El-Mazatly and Mansheyet Abd Elmaged villages had only four locations for each. The locations of these soils have been identified using Geographic Information System (GPS) and Remote Sensing (RS) as shown in Fig. 1.

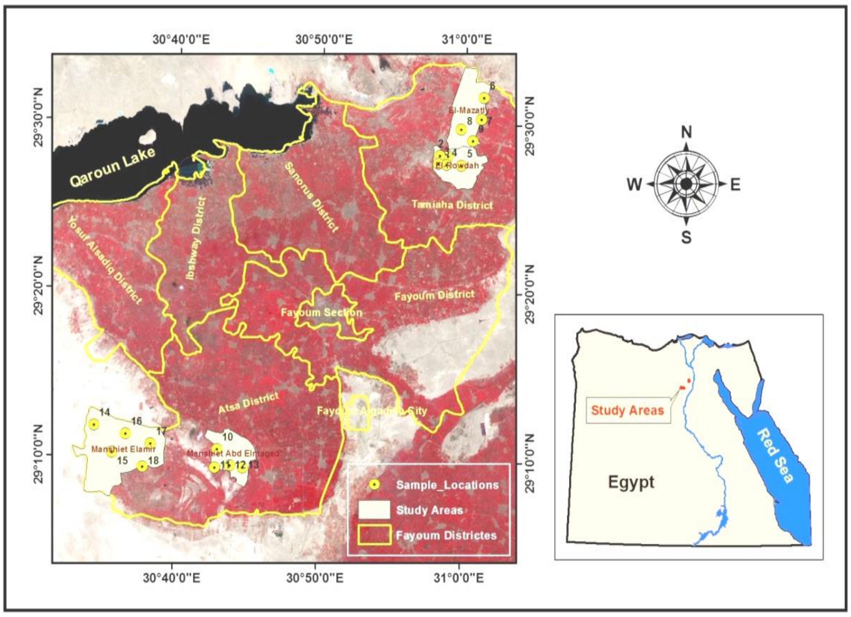

Fig. 1. Map of the studied sites in Fayoum Governorate, Egypt.

Steps of study:

At every site, all the added fertilizers per feddan had stated; as type, quantity, application method and the time of applied as shown in Table 1. Representative samples of soils (0-30 cm), tomato plant (fruits and leaves) and irrigation water were randomly taken from every site.

Additionally, 120 single questionnaire forms were collected by addressing tomato farmers at the studied districts. Questionnaire forms include the costs of production and the profitability, as well as the costs of fertilizers and problems that face farmers.

The study includes also the economic investigation which depends on the data recorded from every site and questionnaire. The research relied on following the inductive method in the economic analysis from the descriptive point of view and following the deductive method in quantitative terms. Furthermore, data was obtained from the Ministry of Agriculture and Land Reclamation, the Economic Affairs Sector, the Central Administration of Agricultural Economy, the General Authority of the Agricultural Budget Fund, the Egyptian Fertilizer Development Center, the Central Agency for Public Mobilization and Statistics, the Food and Agriculture Organization, the Ministry of Economy and Foreign Trade, Industry, some fertilizer companies and samples of tomato fields.

Soils, water and plant samples: -

Samples of soil (0-30 cm) were collected from different sites, 3–5 replicates by an auger using a plastic scooper. Soils were air dried and crushed then sieved through a <0.2 mm sieve and finally stored in the labeled polythene sampling bags.

Water samples were collected from each site in pre-cleaned high-density polyethylene bottles. These bottles were rinsed earlier with a metal-free soap and then soaked in 10% HNO_3 overnight, and finally washed with deionized water. Samples were stored at 4 °C until analysis.

A diversity of tomato crop grown in the study area were collected at different sites from 3–5 replicates and stored in labeled polythene sampling bags and brought to the lab, finally washed with tap water to remove any kind of deposition like soil particles. Straw samples of tomato were air dried and on oven at 70 °C, throne of tomato then oven dried and ground into powdered form for making the plant digested as well as edible parts of tomato yield were digests in fresh weight digested using sulphuric and perchloric acids according to A.O.A.C. (2012).

Soil particle size distribution was carried out using the pipette method; calcium carbonate was determined using the Calcimeter method; organic matter content was determined using the Walkley and Black method (ICARDA 2013); electrical conductivity (Ec) in irrigation water and soil paste extract using electrical conductivity meter (model WTW Series Cond 720); pH values in irrigation water and soil suspensions (1:2.5) were determined using pH meter (model WTW Series pH 720). Cations and anions concentration in water and soil paste extract were determined according to ICARDA (2013).

Available K, P, Fe, Mn, Zn, Cu and B were extracted by AB-DTPA (Soltanpour and Schwab, 1991). Available nitrogen in soil was extracted using KCl (2N); N-NH_4^+ and N-NO_3^- in water; N in soils and plants were determined by using micro-Kjeldahl method according to A.O.A.C. (2012). Nitrate content in fresh tomato fruits was determined using spectrophotometer according to Singh (1988). K in water; soil and plants were determined using flame photometer. P, Fe, Mn, Zn, Cu and B in water, soil and plant were determined using Inductively Coupled Plasma- Spectrometer (ICP- Ultima 2 JY Plasma) according to EPA (1991).

Applied fertilizers:

Data in Table 1 show the quantities of the added fertilizers as farmyard manure (FYM) or chicken manure (CK); single super phosphate 15% P_2O_5 (SSP); phosphoric acid 80% (PA); ammonium sulphate (AS 20.5% N); ammonium nitrate (AN 33.5% N); urea (U 46.5% N), potassium sulphate (SOP 48%K_2O); calcium nitrate (CaN 15% N); magnesium sulphate (MgS 10% Mg); potassium humate (KH) and compound fertilizer NPK (20:20:20).

Table 1. The quantities of added Fertilizers per feddan at every studied site.

Sites code	Organic manures (m^3 fed^{-1})	Phosphate fertilizers as:		Nitrogen fertilizer (Kg fed-1) as:				K_2SO_4 Kg fed^{-1}	Sulfur Kg fed^{-1}	Other fertilizers
		P_2O_5	SSP/PA	N	AS	AN	U			
Rw1	30 FYM	45	300	170	--	300	150	50	40	2kg KH
Rw2	--	45	300	240	--	300	300	150	40	--
Rw3	30 FYM	52.5	350	147	--	300	100	--	40	4 kg KH
Rw4	15 FYM	67.5	450	258	--	700	50	--	40	--
Rw5	30 FYM	75	500	221	150	500	50	--	40	--
Mean		57.0		207						
Mz6	25 FYM	30	200	167	--	500			40	--
Mz7	30 FYM	45	300	187	--	350	150		40	--
Mz8	--	45	300	232.5	--		500		40	--
Mz9	--	37.5	250	198	--	350	175		40	--
Mean		39.4		196						
Mg10	--	22.5	150	170	--	300	150	50	40	--
Mg11	--	22.5	150	170	--	300	150	50	40	--
Mg12	20 FYM	30	200	164	--	350	100	50	40	--
Mg13	40 FYM	22.5	150	193	--	300	200	50	40	--
Mean		24.4		174						
Amr14	30 FYM	48	60L-PA	230	400		200	125	120	120kg NPK (20-20-20)
Amr15	30 FYM	60	75L-PA	215.5	--	250	250	250	120	100kg CaN
Amr16	10 CK	60	75L-PA	259	--	200	300	150	120	150kg CaN+ 7kg KH
Amr17	8 CK	52.5	350	255	--	400	250	100	40	--
Amr18	20 CK	40	50L-PA	259	--	400	200	150	120	200kg CaN+ 25kg MgS
Mean		51.1		244						
*RD/fed	20-30FYM Or 5-10CK	45-60 P_2O_5		120-150 N				48-96 K_2O	40-80 S	

***RD: Recommended doses per feddan according to Ministry of Agricultural and Land Reclamation, Egypt (2016)**

Statistical analysis:

Many analytical tools, mathematical and statistical methods were used to achieve the desired objectives of the research such as the, minimum, maximum and average values, the general time trend and the simple correlations and regression of the relations between the variables. The statistical analysis was done used statistical program COSTAT, according to the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1-Soil characters and its fertility:

Results in Table 2 show a variation in soils texture which ranged from sandy clay loam at Rw1 and 4; Mz6, 7 and 9; Mg10; 11, 12 and 13 and Amr17 to loamy at Rw2, 3 and 5; clay loam at Mz8; sandy loam at Amr 15 and loamy sand at Amr14, 16 and 18. For morphology diagnoses, soils in El-Rowdah, Elmazatly and Mansheyet Abd Elmaged were loamy (black to yellow color) and in Mansheyet Elamir were sandy (yellow color). Some of studied soils at El-Rowdah village (Rw1, Rw2 and Rw3) and Mansheyet Abd Elmaged (Mg12 and Mg13) were affected by salinity (Ec of soils were higher than 4 dSm^{-1}). Moreover, all the studied soils classified as calcareous soils, since they had a high percent of calcium carbonate more than 10 % (ranged from 11.50% in El-Rowdah village to 42.30% in Elmazatly village). The soil reaction was alkaline, as it reached about 8.5 (the lowest was 8.14 and the highest was 8.60).

Table 2. Some physical and chemical properties of studied areas soil (mapping units).

Sites code	Particle size distribution (%)				Texture Class*	pH	Ec dSm^{-1}	O.M %	$CaCO_3$ %
	Coarse sand	Fine sand	Silt	Clay					
Rw1	25.60	27.00	25.00	22.40	S.C.L.	8.41	6.02	1.30	11.50
Rw2	28.30	15.50	38.30	17.90	L.	8.36	4.14	1.50	16.70
Rw3	25.50	13.70	40.50	20.30	L.	8.37	5.80	3.20	14.10
Rw4	36.30	22.10	19.40	22.20	S.C.L.	8.46	3.06	1.25	14.10
Rw5	43.90	7.80	34.50	13.80	L.	8.35	3.30	1.40	12.30
Mean	31.92	17.22	31.54	19.32	L.	8.39	4.46	1.73	13.74
Mz6	27.50	20.00	25.10	27.40	S.C.L.	8.35	3.40	1.30	19.40
Mz7	23.40	25.60	21.90	29.10	S.C.L.	8.60	3.61	1.60	39.60
Mz8	22.80	14.50	24.10	38.60	C.L.	8.33	3.13	1.06	42.30
Mz9	14.00	45.60	14.90	25.50	S.C.L.	8.26	3.44	0.70	24.60
Mean	21.93	26.43	21.50	30.15	S.C.L.	8.38	3.40	1.17	31.48
Mg10	38.60	16.00	20.50	24.90	S.C.L.	8.46	2.55	0.62	27.30
Mg11	38.70	16.30	21.30	23.70	S.C.L.	8.29	3.82	0.76	17.60
Mg12	36.90	21.10	18.70	23.30	S.C.L.	8.37	7.39	0.99	17.60
Mg13	41.30	20.70	16.60	21.40	S.C.L.	8.33	7.84	0.74	22.00
Mean	38.88	18.53	19.28	23.33	S.L.	8.36	5.4	0.78	21.13
Amr14	29.20	54.20	14.20	2.40	L.S.	8.35	3.03	0.12	14.10
Amr15	15.20	55.70	26.40	2.70	S.L.	8.14	2.44	0.40	24.69
Amr16	12.90	71.10	9.20	6.80	L.S.	8.25	2.06	0.50	22.00
Amr17	23.50	26.40	21.40	28.70	S.C.L.	8.17	1.82	0.72	22.00
Amr18	30.90	47.60	16.70	4.80	L.S.	8.42	5.82	0.45	28.22
Mean	22.34	51.00	17.58	9.08	S. L.	8.27	3.03	0.44	22.20
General average	28.58	28.94	22.71	19.77	S.C.L.	8.35	4.07	1.03	21.67

*** S. (Sand), C. (Clay) and L. (Loam)**

Also, data in Table 3 describe the status of soil fertility. It is clear from results that soils were high in its content of available nitrogen, except the soils at the two sites of Rw1 and Rw2 at El-Rowdah village which contain low available N (less than 40 ppm). Also, most of the studied soils were low in available phosphorus content which ranged from 1.5 to 8.8 mg kg^{-1} (Page, 1982). Available potassium varies in the studied areas; as it was moderately in the selective sites of El-Rowdah (429) and Elmazatly villages (292) and ranged from moderately to low in Mansheyet Abd Elmaged (326) and Mansheyet Elamir (168) villages, respectively. Most of the studied areas were high in its content of available iron, manganese and zinc, except the studied location at Mansheyet Abd Elmaged and Mansheyet Elamir village which were moderately to low in their content of available manganese and zinc. Moreover, most of studied soils were high in their content of copper (more than 1 mg kg^{-1}) and low in boron (less than 0.5 mg kg^{-1}).

Table 3. Soil fertility status of available nutrients (mg kg^{-1}) of the studied sites.

Sites code	N	P	K	Fe	Mn	Zn	Cu	B
Rw1	41	8.8	593	9.9	4.3	1.5	2.8	0.44
Rw2	32	3.6	427	10.1	6.0	1.5	2.9	0.31
Rw3	82	3.0	407	9.9	6.6	1.6	3.0	0.41
Rw4	128	2.0	373	9.1	5.2	1.2	2.6	0.42
Rw5	67	5.4	347	10.9	3.3	1.8	2.2	0.32
Mean	70	4.5	429	10.0	5.1	1.5	2.7	0.38
Mz6	212	7.2	257	11.6	4.9	1.4	2.5	0.30
Mz7	128	5.5	407	11.9	5.1	1.9	2.4	0.40
Mz8	188	6.4	233	16.2	6.2	1.5	2.5	0.38
Mz9	66	2.5	270	15.9	6.7	2.3	2.4	0.35
Mean	149	5.4	292	13.9	5.7	1.8	2.4	0.36
Mg10	113	2.2	330	9.8	3.8	1.1	3.0	0.22
Mg11	94	2.5	270	10.1	3.6	1.0	3.4	0.18
Mg12	92	1.5	377	7.6	4.1	1.0	2.9	0.19
Mg13	131	1.9	327	6.6	5.4	0.7	2.3	0.23
Mean	108	2.0	326	8.5	4.2	0.9	2.9	0.20
Amr14	80	5.2	300	4.5	4.7	0.8	0.8	0.28
Amr15	112	4.3	190	5.6	3.9	0.7	1.1	0.21
Amr16	107	9.0	117	6.9	6.6	1.0	1.4	0.35
Amr17	92	8.3	125	8.4	6.2	0.8	1.6	0.19
Amr18	66	2.8	110	7.0	4.4	0.9	1.1	0.16
Mean	91	5.9	168	6.5	5.2	0.8	1.2	0.24
Minimum	32	1.5	110	4.5	3.3	0.7	0.8	0.16
Maximum	212	9.0	593	16.2	6.7	2.3	3.4	0.44
General average	105	4.6	317	9.8	5.1	1.3	2.4	0.31
Critical level*	40-80	3-7	200-400	4-6	2-5	1-2	0.5-1	0.5-1

*** According to Page, (1982) and Hamissa *et al.*, (1993).**

2- Irrigation water quality: -

Data in Table 4 show the chemical analysis of irrigation water. It is obvious that degree of water quality in Tamiya district was low (C_4S_1) and limited for use. Also, in Etsa district, the quality of irrigation water ranged from C_3S_1 to C_4S_2, and is considered limited for use too, especially at locations of Mg12 and Mg13, where the irrigation water is very high in salinity and had medium ratio of SAR. For nitrate concentration, irrigation water is classified from slight to moderate degree of problem (mostly > 5 and less than 30), however irrigation water in Mansheyet Abd Elmaged had the highest concentration of nitrate (24.1 mg L^{-1}). For boron concentration, irrigation water was low and suitable for crops and safe use.

Generally, irrigation water quality was low in case of most of the studied locations, especially in Tamiya district, but could be used for irrigating salt tolerant crops like tomato with very special conditions; such as the soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt-tolerant crops should be selected (Richards, 1954). Accordingly, tomato is one of the salt-tolerant crops; as well as soils in Tamiya are considered light, where texture ranged from sandy clay loam to loamy (Table 2).

Table 4. Chemical properties of irrigation water of the studied locations areas and classes of quality (I.W.Q.).

Sites code	pH	EC dSm^{-1}	Cations (Meq L^{-})				Anions (Meq L^{-})				SAR	RSC	*Class I.W.Q.	NH_4	NO_3^-	B	Fe	Mn	Zn	Cu
			Ca	Mg	Na	K	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}										
Rw1	7.80	3.52	9.80	7.81	16.96	0.44	**N.D.	5.66	11.25	18.10	5.71	0.00	C4S1	2.45	7.6	0.188	0.229	0.120	0.031	N.D.
Rw2	7.80	3.80	11.10	6.73	19.57	0.53	N.D.	6.13	11.88	19.92	6.55	0.00	C4S1	0.98	15.6	0.132	0.228	0.237	0.032	N.D.
Rw3	8.20	2.92	9.82	3.93	15.01	0.42	0.38	3.02	6.00	19.78	5.72	0.00	C4S1	2.52	15.2	0.100	0.054	N.D.	N.D.	N.D.
Rw4	7.80	2.96	9.16	4.60	15.36	0.39	0.38	2.83	6.25	20.05	5.86	0.00	C4S1	0.56	9.6	0.099	0.002	0.002	N.D.	N.D.
Rw5	7.90	2.97	7.35	5.67	16.09	0.45	0.94	2.83	6.13	19.66	6.31	0.00	C4S1	0.56	10.3	0.081	0.278	0.058	N.D.	N.D.
Mean	7.90	3.23	9.44	5.75	16.60	0.45	0.34	4.09	8.30	19.50	6.03	0.00	C4S1	1.41	11.7	0.120	0.158	0.083	0.013	N.D.
Mz6	7.50	2.85	7.53	5.87	14.66	0.37	N.D.	4.25	9.38	14.80	5.66	0.00	C4S1	0.77	4.9	0.101	N.D.	N.D.	N.D.	N.D.
Mz7	8.00	2.88	10.46	3.54	14.31	0.38	N.D.	4.25	9.38	15.06	5.41	0.00	C4S1	0.98	5.0	0.054	0.040	0.084	N.D.	N.D.
Mz8	8.00	2.43	5.99	4.29	13.60	0.33	N.D.	4.01	9.38	10.82	6.00	0.00	C4S1	1.05	11.6	0.061	0.235	0.001	N.D.	N.D.
Mz9	8.10	3.35	10.59	6.76	15.71	0.37	N.D.	5.66	11.25	16.52	5.34	0.00	C4S1	N.D.	11.6	0.039	0.028	N.D.	0.053	N.D.
Mean	7.90	2.88	8.64	5.11	14.57	0.36	N.D.	4.54	9.84	14.30	5.60	0.00	C4S1	0.70	8.3	0.064	0.076	0.021	0.013	N.D.
Mg10	7.30	1.50	5.23	3.38	6.00	0.38	N.D.	4.72	5.00	5.27	2.89	0.00	C3S1	0.28	24.1	0.142	0.608	0.117	0.685	N.D.
Mg11	7.30	1.50	5.23	3.38	6.00	0.38	N.D.	4.72	5.00	5.27	2.89	0.00	C3 S1	0.28	24.1	0.120	0.045	0.117	0.685	N.D.
Mg12	7.70	5.94	11.99	11.34	35.65	0.30	N.D.	6.60	15.63	37.05	10.44	0.00	C4 S2	N.D.	19.9	0.532	0.031	0.027	0.423	0.008
Mg13	7.70	6.31	12.53	9.52	40.00	0.98	N.D.	6.80	16.43	39.80	10.44	0.00	C4 S2	N.D.	19.5	0.226	0.022	0.019	0.652	0.010
Mean	7.52	3.81	8.78	6.81	22.13	0.52	N.D.	5.53	10.63	21.85	6.67	0.00	C4S1	0.14	22.0	0.255	0.177	0.067	0.570	0.005
Amr14	7.90	2.79	5.82	4.47	15.26	2.23	N.D.	3.77	10.00	14.01	6.73	0.00	C4S1	1.33	25.2	0.291	0.021	N.D.	N.D.	N.D.
Amr15	7.80	2.04	6.12	2.37	11.49	0.38	N.D.	3.77	6.25	10.34	5.58	0.00	C3S1	N.D.	14.9	0.101	0.041	N.D.	N.D.	N.D.
Amr16	7.70	2.81	7.91	6.09	13.60	0.42	N.D.	4.01	9.38	14.63	5.14	0.00	C4S1	N.D.	18.6	0.102	0.029	N.D.	N.D.	N.D.
Amr17	7.50	1.19	3.72	1.78	5.83	0.37	N.D.	4.25	5.00	2.45	3.51	0.00	C3S1	0.63	10.6	0.074	0.030	N.D.	N.D.	N.D.
Amr18	7.80	2.05	6.12	2.37	11.49	0.38	N.D.	3.77	6.25	10.34	5.58	0.00	C3S1	N.D.	14.9	0.025	0.041	N.D.	N.D.	N.D.
Mean	7.74	2.18	5.94	3.42	16.13	0.76	N.D.	3.92	8.38	10.35	7.34	0.00	C4S1	0.39	16.8	0.119	0.032	N.D.	N.D.	N.D.
Critical level	6.5-8.0	<0.25							4-7		<10	<1.25	C1S1	5	5-30	0.75	0.20	0.20	0.20	0.20

*** I.W.Q. and critical level according to Wilcox (1948) and Richards (1954). **N.D. means not detected.**

3-Tomato yield: -

Data in Table 5 show the productivity of tomato represented as kg plant^{-1} and t. fed^{-1}. The highest tomato yield (46.548 t. fed^{-1}) was recorded at site Amr_{15} in Mansheyet Elamir (Etsa district), where the added fertilizers were 30 m^3 FYM fed^{-1} (basal application before transplanting), 60 kg P_2O_5 (75 litre phosphoric acid), 215.5 kg N (as 250 kg ammonium nitrate + 250 kg urea+ 100 kg calcium nitrate), 250 kg potassium sulfate fertilizer, 120 kg sulfur and with 1 kg micronutrients chelates (Fe+Mn+Zn) through drip irrigation system as fertigation. On the other hand, the lowest yield (19.350 t. fed^{-1}) was obtained at Mz_9 location in Elmazatly village (Tamiya district), where the applied fertilizers were 37.5 kg P_2O_5 (250 kg calcium superphosphate), 198 kg N (350 kg ammonium nitrate+ 175 kg urea) and 40 kg sulfur, and irrigation was surface in furrows.

Additionally, the studied sites at Mansheyet Elamir village had the highest mean of total yield (40.031 t. fed^{-1}), where mostly the allowed fertilization was through the drip irrigation system as fertigation. However, for traditional agriculture that allowed at other studied sites (old soils and surface irrigation in furrows), El-Rowdah village had the highest mean of the total yield (30.773 t. fed^{-1}), with the superiority of the studied sites Rw_4 (39.937 t. fed^{-1}) and Rw_5 (37.370 t. fed^{-1}), as a result of the applied fertilizers at the rates that ranged from 15 - 30 m^3 FYM, 67.5 -75 kg P_2O_5, 258 - 221 kg N and 40 kg sulfur per fed. In case of the straw yield (kg fed^{-1}), it is positively correlated with tomato productivity per plant and fed., and with the superiority of the above-mentioned locations too (Table 5).

Table 5. Tomato yield (fruits and straw).

District	Village	Sites code	Fruits yield		Dry straw weight (Kg fed^{-1})
			Kg plant^{-1}	t. fed^{-1}	
Tamiya	El-Rowdah	Rw1	3.414	26.023	1943
		Rw2	3.428	27.420	2877
		Rw3	2.890	23.116	2360
		Rw4	4.992	39.937	3213
		Rw5	4.671	37.370	2823
		Mean	3.879	30.773	2643
	Elmazatly	Mz6	2.697	21.573	2320
		Mz7	2.825	22.603	2240
		Mz8	2.770	22.160	2357
		Mz9	2.419	19.350	1700
		Mean	2.678	21.422	2154
Etsa	Mansheyet Abd Elmged	Mg10	3.516	28.127	3143
		Mg11	3.768	37.677	3803
		Mg12	3.777	30.213	2050
		Mg13	3.000	24.003	1633
		Mean	3.515	30.005	2658
	Mansheyet Elamir	Amr14	6.411	41.029	2967
		Amr15	7.273	46.548	4310
		Amr16	6.961	44.552	2100
		Amr17	5.180	33.152	3480
		Amr18	5.449	34.872	2600
		Mean	6.255	40.031	3091
Minimum			2.419	19.350	1633
Maximum			7.273	46.548	4310
General average			4.059	31.096	2615

Correlations between total yield and the added fertilizers:-

It is clear from Fig. 2 that total yield significantly correlated with application rates of nitrogen, phosphorus, and potassium, where the correlation coefficient values were 0.519*, 0.496* and 0.646**, respectively. However, the total yield insignificantly correlated with the added of organic manures, where the correlation coefficient value was 0.348ns. These results demonstrate the importance of application phosphorus and potassium fertilizers beside nitrogen to recognize the balance that attained the optimum yield.

Additionally, it is obvious from Table 6 that the total tomato yield is negatively correlated with soil content of salts (Ec value) and calcium carbonate. On the other hand, soil content of most nutrients are negatively correlated with total yield, where the productivity increased the uptake of nutrients increased, and as a consequence the residual of nutrients in soil decreased. Concerning correlations among soil characters (EC and calcium carbonate), its fertility and the applied fertilizers, it is obvious from Table 6 that soil fertility as its content of nutrients is negatively correlated with Ec, except the available K which is positively correlated. Moreover, the available copper and boron are significantly correlated with available of potassium, iron and zinc. Also, the available K is significantly correlated with soil Ec positively, but negatively with $CaCO_3$.

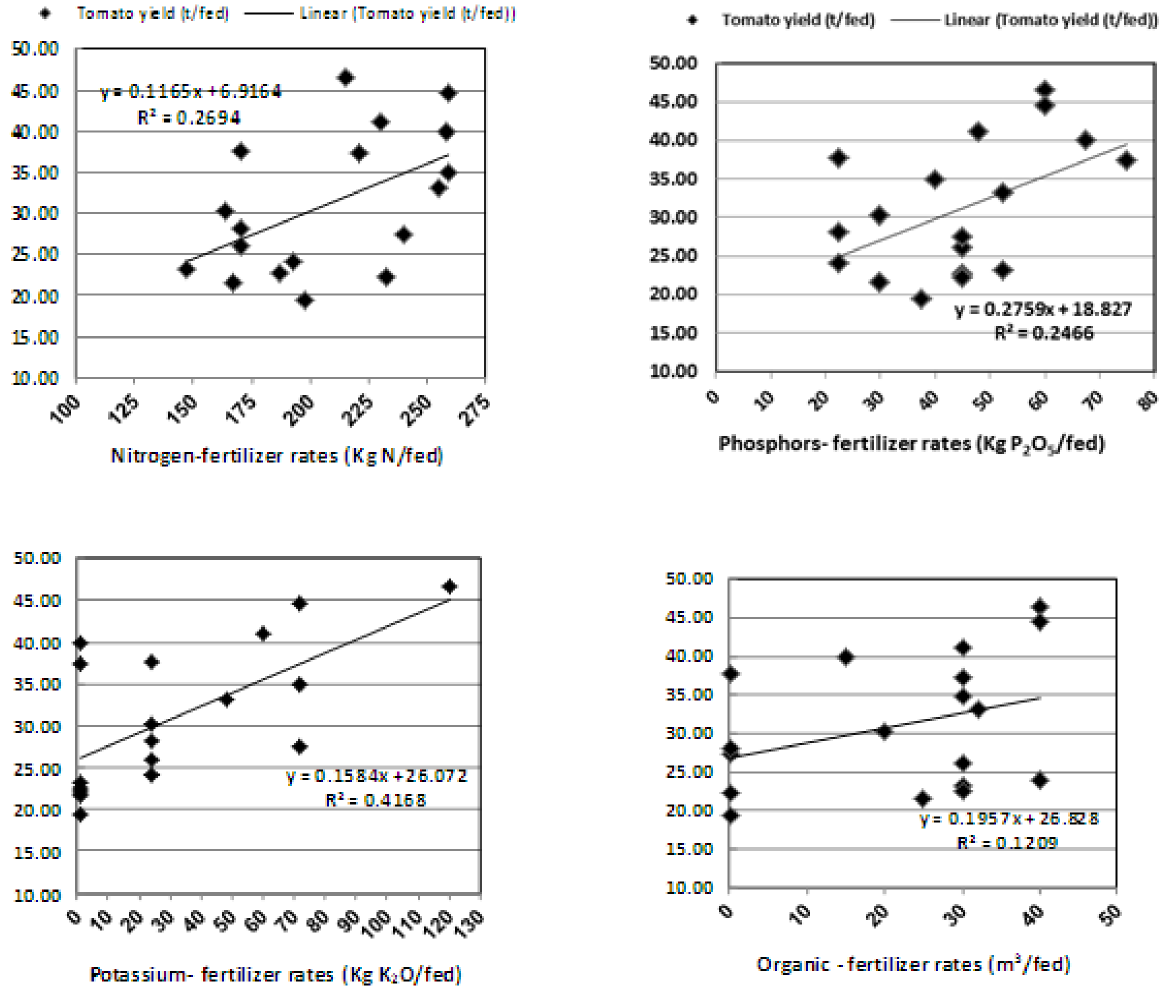

Fig. 2. Regression between the applied fertilizers rates of nitrogen, phosphorus, potassium and organic manure and tomato yield (t. fed^{-1}).

Table 6. Correlation relationships among the applied fertilizers of N and P_2O_5, soil status of nutrients, salinity and calcium carbonate and tomato yield.

Variables	N rates	P_2O_5 rates	Soil fertility as the available of:								EC	$CaCO_3$	Yield
			N	P	K	Fe	Mn	Zn	Cu	B			
N-rates	1												
P_2O_5-rates	0.45**	1											
avil. N	-0.05	-0.19	1										
avil. P	0.37**	0.30*	0.07	1									
avil. K	-0.46**	-0.07	-0.32*	-0.27	1								
avil. Fe	-0.21	-0.10	0.21	-0.02	0.17	1							
avil. Mn	0.25	0.10	0.02	0.23	-0.27	0.24	1						
avil. Zn	-0.28*	0.15	-0.14	-0.04	0.38**	0.77**	0.21	1					
avil. Cu	-0.63**	-0.39**	-0.03	-0.47**	0.60**	0.47**	-0.17	0.40**	1				
avil. B	-0.12	0.44**	-0.004	0.10	0.51**	0.40**	0.20	0.57**	0.19	1			
EC	-0.38**	0.01**	-0.28	-0.05	0.27*	-0.03	-0.19	0.09	0.15	0.01	1		
$CaCO_3$	0.14	-0.22	0.48**	0.14	-0.34*	0.42**	0.26	0.11	-0.12	-0.02	-0.19	1	
Yield	0.48**	0.45**	-0.14	0.11	-0.40**	-0.61**	-0.27	-0.52**	-0.51**	-0.21	-0.03	-0.26	1

avil. = available; *= significant at the 0.05 level; **= significant at the 0.01 level (2-tailed)

4- Chemical analysis of tomato fruits.

Data in Table 7 indicate that the studied sites of Mansheyet Abd Elmaged village had the highest mean of nitrate content in tomato fresh fruits (1545 mg kg^{-1}) followed by Elmazatly (1055 mg kg^{-1}) and El-Rowdah (881 mg kg^{-1}) then Mansheyet Elamir (778 mg kg^{-1}). Furthermore, the highest nitrate content (1840 mg kg^{-1}) was obtained at samples of the studied site Mg_{11} at Mansheyet Abd Elmaged village, where the total nitrogen fertilizer applied was 170 kg N fed^{-1} (as 300 kg ammonium nitrate+ 150 kg urea), without organic manure application. On contrast, the lowest nitrate content (550 mg kg^{-1}) was obtained at the studied site of Amr_{14} at El-Rowdah village, where the applied nitrogen fertilizer was 230 kg N fed^{-1} (as 400 kg ammonium sulfate+ 200 kg urea) with 30 m^3 FYM. These results agree with Rousta *et al.,* (2010) who found that the means of nitrate in fresh tomato ranged from 754 to 1272 mg kg^{-1}.

Table 7. Chemical analysis of fresh fruits (mg kg^{-1}).

Sites code	NO_3^-	N	P	K	Fe	Mn	Zn	Cu	B
	mg kg^{-1}								
Rw1	914	1070	41	252	27	0.85	0.49	0.13	0.49
Rw2	706	1328	80	351	37	1.22	0.86	0.46	0.66
Rw3	648	1423	43	318	40	2.45	1.18	1.09	2.24
Rw4	1191	1224	65	249	36	1.48	0.88	0.31	0.52
Rw5	947	1100	70	373	35	1.02	0.92	0.21	0.56
Mean	881	1229	60	309	35	1.43	0.87	0.44	0.88
Mz6	1281	1349	43	320	43	0.66	0.50	0.67	2.60
Mz7	1022	1366	64	322	58	1.78	0.77	1.00	0.84
Mz8	660	1288	43	323	43	0.64	0.64	0.89	1.03
Mz9	1256	1355	43	333	43	1.64	0.79	1.10	0.98
Mean	1055	1339	48	325	47	1.24	0.67	0.92	0.88
Mg10	1307	1369	50	271	55	3.90	2.03	2.62	4.24
Mg11	1798	1840	52	256	44	2.20	1.29	1.51	2.47
Mg12	1189	1303	53	340	53	4.12	1.50	2.38	2.40
Mg13	1569	1668	52	311	41	2.88	1.26	1.46	1.62
Mean	1466	1545	52	294	48	3.28	1.52	2.00	2.68
Amr14	550	1064	73	296	31	2.20	1.01	1.32	1.65
Amr15	1296	1355	53	301	22	1.67	1.09	1.16	1.49
Amr16	748	910	60	245	33	2.00	0.99	1.13	1.59
Amr17	654	1205	50	272	42	2.11	1.24	1.56	1.36
Amr18	641	1384	111	379	20	2.28	1.36	1.24	1.97
Mean	778	1183	69	299	30	2.05	1.14	1.28	1.61
Minimum	550	910	41	245	20	0.66	0.49	0.13	0.49
Maximum	1798	1840	111	379	58	4.12	2.03	2.62	4.24
General average	1021	1311	60	304	40	1.96	1.03	1.11	1.47

Also, these results may be attributed to source of N-fertilizer and to the uptake of N than the added of fertilizer. In this respect, Ahmed and Morsy (2005) and Fouda, (2017) found that the most suitable treatment which realized the highest safe yield for nitrate content in tomato fruits was the treatment of 120 kg N fed^{-1} as ammonium sulfate, 60 kg P_2O_5 fed^{-1} and 48 kg K_2O fed^{-1}, but tomato fruits content of nitrate was significantly higher with urea and ammonium nitrate fertilizers than ammonium sulfate.

According to World Health Organization (WHO, 1978) standards, the safe nitrate level in tomatoes is 300 mg kg^{-1} of fresh weight. Concerning the studied sites, all the analyzed tomatoes present nitrate levels was higher than accepted standards of WHO. However, the critical level of nitrate is related with a dietary intake of nitrate; the concentration of nitrate in vegetables can vary considerably, reaching sometimes as much as 3-4 g kg^{-1} fresh weight and these levels could have potential health impacts (WHO, 1978; Simion *et al.,* 2008 and Rousta *et al.,* 2010).

For nutritive value of tomato yield and its content of nutrients, variation exists among the studied sites, and approximately near the normal level (Table 7). For fruits content of nitrogen and potassium the studied sites in Elmazatly village had the highest means followed by El-Rowdah sites. Concerning phosphorus content, the studied locations in Mansheyet Elamir had the highest content followed by that of El-Rowdah village. Moreover, the studied sites in Mansheyet Abd Elmaged had the highest mean of iron, manganese, zinc, copper and boron content then followed by that of Mansheyet Elamir sites.

5- Nutrients Uptake (kg fed^{-1}): -

a- Nutrients uptake of fruits yield: -

Data in Table 8 show fruits yield uptake of N, P, K, Fe, Mn, Zn, Cu and B as kg fed^{-1}. It is obvious from the obtained results that the variations existing among the studied sites and villages are associated with its productivity of total tomato yield (Table 6). Generally, the studied sites at Mansheyet Elamir village had the highest means of nutrients uptake of fruits yield followed by the means of the studied sites of El-Rowdah village. The lowest mean of nutrients uptake of fruits was obtained in case of sites studied in Elmazatly village (Tamiya district).

Table 8. Nutrients uptake of fruit yield (kg fed^{-1}).

Sites code	N	P	K	Fe	Mn	Zn	Cu	B
Rw1	27.86	1.07	6.50	0.71	0.025	0.013	0.003	0.013
Rw2	34.41	2.26	9.10	0.99	0.033	0.024	0.013	0.017
Rw3	33.05	1.00	7.37	0.93	0.056	0.027	0.025	0.052
Rw4	48.70	2.59	9.98	1.44	0.059	0.036	0.012	0.021
Rw5	41.17	2.63	13.93	1.29	0.038	0.034	0.008	0.021
Mean	37.04	1.91	9.38	1.07	0.043	0.027	0.012	0.025
Mz6	29.04	0.92	6.95	0.94	0.014	0.010	0.014	0.016
Mz7	30.80	1.45	7.31	1.31	0.040	0.017	0.023	0.019
Mz8	28.90	0.98	7.24	0.97	0.020	0.015	0.020	0.022
Mz9	25.86	0.82	6.38	0.83	0.032	0.015	0.021	0.018
Mean	28.65	1.04	6.97	1.01	0.026	0.015	0.020	0.019
Mg10	38.57	1.42	7.61	1.53	0.109	0.057	0.074	0.118
Mg11	69.44	1.91	9.59	1.66	0.083	0.049	0.057	0.091
Mg12	37.45	1.68	10.36	1.63	0.124	0.044	0.067	0.072
Mg13	39.76	1.21	7.44	0.99	0.067	0.029	0.035	0.038
Mean	46.31	1.56	8.75	1.45	0.096	0.045	0.058	0.080
Amr14	43.54	2.98	12.21	1.26	0.091	0.041	0.054	0.068
Amr15	63.63	2.56	14.15	1.01	0.078	0.051	0.054	0.069
Amr16	40.57	2.65	10.89	1.51	0.090	0.044	0.051	0.070
Amr17	39.26	1.61	8.89	1.37	0.069	0.041	0.051	0.046
Amr18	48.26	3.87	13.22	0.71	0.079	0.047	0.043	0.069
Mean	47.05	2.74	11.87	1.17	0.081	0.045	0.050	0.064
Minimum	25.86	0.82	6.38	0.71	0.014	0.010	0.003	0.013
Maximum	69.44	3.87	14.15	1.66	0.124	0.057	0.074	0.118
General average	40.01	1.87	9.40	1.19	0.062	0.033	0.035	0.047

Additionally, it is obvious from results in Table 9 that fruits content of nitrate are significantly correlated with the uptake of nitrogen rather than amounts of the applied nitrogen fertilizers; also the uptake of nutrients is significantly correlated with yield. Although, there are no clear correlations among applied rates of nitrogen and the uptake, the uptake of phosphors and potassium are significantly correlated with applied fertilizers. This may be attributed to high soil content of available N, as well as soil properties of every location which may be considered as limitation factors such as high soil content of calcium carbonate and pH.

Table 9. Correlation relationships among the added fertilizers of N and P_2O_5, tomato yield, nitrate content and nutrients uptake in fruits.

Variables	N rates	P_2O_5 rates	Yield	NO_3^-	nutrients uptake							
					N	P	K	Fe	Mn	Zn	Cu	B
NO_3^-	-0.33*	-0.42**	0.06									
N-uptake	0.16	0.07	0.75**	0.34*	1							
P-uptake	0.60**	0.38**	0.77**	-0.14	0.54**	1						
K-uptake	0.43**	0.43**	0.81**	-0.03	0.66**	0.78**	1					
Fe-uptake	0.02	-0.02	0.47**	0.27	0.35**	0.14	0.27*	1				
Mn-uptake	0.01	-0.19	0.55**	0.13	0.49**	0.40**	0.45**	0.63**	1			
Zn-uptake	0.20	0.01	0.75**	0.15	0.71**	0.62**	0.62**	0.51**	0.80**	1		
Cu-uptake	-0.02	-0.37**	0.42**	0.17	0.48**	0.25	0.29*	0.48**	0.86**	0.77**	1	
B-uptake	-0.09	-0.327*	0.47**	0.19	0.55**	035*	0.36**	0.47**	0.82**	0.83**	0.88**	1

***= significant at the 0.05 level; **= significant at the 0.01 level (2-tailed)**

b- Nutrients uptake of straw (kg fed^{-1}):

Data in Table 10 show that nutrients uptake of straw (kg fed^{-1}) as affected by variations among studied sites and villages. The lowest mean of nutrients uptake per straw was obtained at sites studied in Elmaztly village. The highest uptake of P, K, Mn, Zn, Cu and B were recorded at the studied sites in Mansheyet Elamir village, followed by the studied sites in El-Rowdah village. Generally, the studied locations Rw_4, Rw_5, Mg_{11} Amr_{15} and Amr_{17} had higher shoot uptake of nutrients as compared with other studied sites.

Table 10. Nutrients uptake of straw (kg fed^{-1}).

Sites code	N	P	K	Fe	Mn	Zn	Cu	B
Rw1	40.49	7.90	40.63	0.716	0.165	0.068	0.033	0.054
Rw2	54.92	12.53	69.43	0.675	0.227	0.091	0.055	0.083
Rw3	49.14	9.16	34.99	1.103	0.222	0.089	0.049	0.071
Rw4	61.10	11.91	85.78	0.811	0.246	0.132	0.064	0.098
Rw5	59.61	11.82	50.29	0.964	0.158	0.118	0.050	0.087
Mean	53.05	10.66	56.23	0.854	0.204	0.099	0.050	0.079
Mz6	42.40	9.91	43.55	0.918	0.128	0.088	0.060	0.073
Mz7	44.06	10.36	48.83	1.093	0.135	0.089	0.060	0.061
Mz8	46.76	9.32	46.39	0.707	0.099	0.080	0.050	0.077
Mz9	40.83	9.38	32.35	0.647	0.187	0.093	0.038	0.055
Mean	43.51	9.74	42.78	0.841	0.137	0.088	0.052	0.067
Mg10	71.80	15.39	58.83	1.003	0.215	0.118	0.065	0.108
Mg11	77.15	18.60	67.55	1.633	0.252	0.132	0.069	0.122
Mg12	41.29	9.16	41.79	0.924	0.131	0.072	0.036	0.070
Mg13	36.05	7.78	23.46	0.671	0.149	0.044	0.034	0.054
Mean	56.57	12.73	47.91	1.058	0.187	0.092	0.051	0.088
Amr14	55.29	13.98	73.52	0.832	0.173	0.051	0.034	0.074
Amr15	67.54	15.44	91.48	1.797	0.292	0.136	0.102	0.116
Amr16	40.16	23.51	26.37	0.718	0.287	0.088	0.047	0.073
Amr17	58.16	29.42	56.50	1.128	0.406	0.136	0.086	0.123
Amr18	32.79	13.71	61.00	0.751	0.149	0.083	0.031	0.076
Mean	50.79	19.21	61.77	1.045	0.261	0.099	0.060	0.092
Minimum	32.79	7.78	23.46	0.647	0.099	0.044	0.031	0.054
Maximum	77.15	29.42	91.48	1.797	0.406	0.136	0.102	0.123
General average	51.09	13.29	52.93	0.949	0.201	0.095	0.053	0.082

6- Economic analysis:-

The obtained results of questionnaire forms showed that there are problems that faces growing tomatoes in Fayoum Governorate, some of them have economic dimension and other have environmental dimension. Pesticides and fertilizers represented about 51.7%; non-follow-up and diminishing agriculture extension represented about 26.7%; increasing the quantities of added fertilizers and death of seedlings in the early stages represented about 25.0%; low experience of farmers represented about 15.0%; insect injuries represented about 12.5%.

The analysis of the economic effects of the applied chemical fertilizers on the productivity of tomato crop for farmers sample (120 questionnaire forms was preformed). In order to study this relationship, the statistical hypothesis was formulated: "there is no significant relationship between the amount of added fertilizers and the productivity of the tomato yield for the samples of the study". Data in Table 11 show that correlation relationships between the added fertilizers and productivity of tomato was significant at 0.01 for phosphate, potassium, sulfur and other fertilizers, but insignificant for nitrogen fertilizers (as nitrate or urea) and organic manure.

Table 11. The correlation coefficient between the added fertilizers and the tomato productivity.

Fertilizers (Independent variables)	Tomato yield (Dependent variable)
Nitrogen-Nitrate	0.116
Nitrogen-Urea	0.227
Phosphate	0.442**
Potassium	0.349**
Organic manures	0.106
Sulfur	0.304**
Other fertilizers	0.361**

*** Significant at 0.05; ** Significant at 0.01**

Also, data in Table 12 represent the correlation and multiple regression of the relationship of fertilization with productivity. The ratio of these variables in the interpretation of the total variability of the tomato yield was significant at 0.01, and the percentage of their contribution together in the predictive capacity of interpretation is about 58.4% for other factors, the contribution rate of phosphorus fertilizers about 42.2%, the contribution of potassium fertilization about 9.2%, and the contribution of other fertilizers was about 5%.

Table 12. The correlation and multiple regression analysis of the relationship of fertilization with productivity.

Variables	Multiple correlation coefficient	% Interpreted variance of the dependent variable	% Explanatory difference of the dependent variable	Regression coefficient
Phosphate	0.442	46.2	42.2	0.45
Potassium	0.534	53.3	9.2	16.0
Other fertilizers	0.548	55.4	5.0	0.89

Source: collected and calculated from the data in the study samples in Fayoum Governorate, season 2016/2017.

Finally, it is obvious from the above mentioned results that the most significant variables contributing to the interpretation of the total variability of the tomato yield in the samples of the Fayoum Governorate were the amounts of applied phosphorus and potassium fertilizers rather than the amounts of nitrogen fertilizers. Furthermore, results reveal that there is excessive use of chemical nitrogen fertilizers without positive return on yield, where the correlation between them was insignificant. Moreover, the continuous excessive application of chemical nitrogen fertilizers may affect the environment and cause big risks, where the concentration of nitrate in the analyzed tomatoes samples was higher than the standard level (300 mg kg^{-1}) according to WHO (1978). Therefore, the integration of fertilization through applications of organic manures, fertilizers of phosphorus, potassium, and micronutrients with nitrogen fertilizer is the best to attain optimum yield of tomato that had the lowest accumulation of nitrate and best return.

CONCLUSION

It could be concluded that great attention should be paid to phosphorus and potassium fertilization for tomato grown under the ecological conditions of Fayoum Governorate", considering the soils content of nutrients for fertilizer rationalized, without excessive of nitrogen fertilizer addition.

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التقييم الأجرو-إقتصادي للأسمدة المضافة للطماطم المنزرعة بمحافظة الفيوم- مصر

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تراجعت المساحات المنزرعة بمحصول الطماطم وإنتاجيتها في السنوات الأخيرة بمصر نظراً لبعض الأسباب من بينها التسميد؛ ولذا أجريت هذه الدراسة لتقييم تأثير الأسمدة المضافة للطماطم المزروعة بمحافظة الفيوم – مصر (29° 18' 30"N; 30° 50' 39"E) على المحصول الكلى وإمتصاص العناصر وتراكم النترات بالثمار وتحليل العلاقات بين خصوبة التربة وكميات الأسمدة المضافة والإنتاجية، بالإضافة لتقييم جودة وصلاحية مياه الرى حيث تم إختيار ثمانية عشر موقعاً (حقل طماطم) بأربعة قرى بمركزين وفقاً لمساحة الطماطم الكلية المزروعة بالعروة الخريفية 2016 - 2017، أخذت عينات ممثلة من التربة والنبات (ثمار وعروش) ومياه من مصدر الرى من كل موقع للتحليل؛ وكما تم جمع 120 إستمارة إستبيان من مزارعى الطماطم بأماكن الدراسة. هذا وقد أوضحت النتائج إلى أن الأراضى تحت الدراسة كانت مرتفعة فى محتواها من النيتروجين وأغلب العناصر الصغرى، ومنخفضة فى محتواها من الفوسفور ومتوسطة إلى منخفضة من البوتاسيوم، كما تراوحت صلاحية مياه الرى من منخفضة إلى متوسطة الصلاحية. وقد تراوحت الإنتاجية الكلية لمحصول الطماطم من 19,350 إلى 46,548 طن للفدان بمتوسط 31,096 طن؛ فى حين تراوحت الأسمدة المضافة للفدان من 147- 259 كجم نتروجين، ومن 22,5- 75 كجم خامس اكسيد الفوسفور؛ ومن صفر - 96 أكسيد بوتاسيوم. هذا وقد إرتبط محصول الطماطم معنوياً بمعدلات الأسمدة المضافة من النيتروجين والفوسفور والبوتاسيوم وغير معنوياً مع السماد العضوى؛ كما إرتبط تراكم النترات بالثمار معنوياً مع الممتص من النيتروجين فى حين كانت العلاقة غير معنوية بين كمية السماد النيتروجيني المضاف والممتص منه؛ علاوة على ذلك أوضحت نتائج تحليل إستمارات الإستبيان إرتباط إنتاجية محصول الطماطم معنوياً بمعدلات الأسمدة المضافة من الفوسفور والبوتاسيوم وغير معنوياً مع المعدلات المضافة من السماد النتروجينى والعضوى. لذا يجب تعظيم الإهتمام بالأسمدة الفوسفاتية والبوتاسية دون الإفراط فى إضافة السماد النتروجينى مع الأخذ بعين الإعتبار محتوى التربة من العناصر الغذائية لترشيد السماد.