EFFECT OF SOIL ADDITION AND FOLIAR SPRAY WITH SOME GROWTH STIMULANTS ON GROWTH AND PRODUCTIVITY OF TOMATO GROWN UNDER NEW RECLAIMED SOIL CONDITIONS

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ABSTRACT

Two field experiments were carried out during the two successive winter seasons of 2016-2017 and 2017-2018 in private sector farm at ElshikhMasoud Village, Eledwa Center, El-Minia Governorate, to investigate the effect of soil addition of effective microorgɑnisms(EM) at 150ml/l, humic acid at 2g/l and seaweed extract at 2g/l and the foliar spray with NAA at 50ppm, salicylic acid at 2g/l and monopotassium phosphate at 2g/l as well as their interaction on growth, chemical composition, fruit yield and its quality of tomato plants (*Solanumlycopersicum* Mill) cv. Hybrid 010. This experiment included 16 treatments which were the combination of four soil addition treatments combined with four foliar spray treatments. The soil addition treatments were added beside plants three times starting 7 days after transplanting and every 10 days by intervals. The spray treatments were started after 21 days from transplanting and every 10 days by intervals for three times through the growing season. A split plot design with four replicates was adopted in this experiment where the soil addition treatments were located in the main plots and the foliar spray treatments were distributed randomly in the sub plots. The obtained results showed that soil addition of seaweed extract at 2g/l to the soil three times during the growing season after 7 days from transplanting and every 10days by intervals combined with spraying the plants with 2 g/l salicylic acid three times after 3 weeks and every 10 days by intervals was recommended to obtain good vegetative growth and higher fruit yield with best quality.

Key words:- tomato – soil addition – foliar spray – growth stimulants.

1. INTRODUCTION

Tomato (*Solanumlycopersicum,* Mill.) is considered as one of the most important crops as well as popular vegetable all over the world. In addition, tomato represents one of the important vegetable crops grown in Egypt for local consumption and export. The cultivated area estimated by 468510 fed with an average yield of 16.49 tons per fed (Ministry of Agriculture and Land Reclamation A. R. Egypt, 2015). In recent years, the world focused his attention to minimize environmental pollution and human health impacts by reducing the use of synthetic fertilizers and chemicals in crop production, especially, vegetables which are eaten as fresh by using natural alternatives. Several investigations used some nutritional safety compounds such as natural extracts which are nontoxic and environmentally friendly, organic and costless either as foliar spray or soil application to enhance plant growth with maximizing the yield.

Tomato production is limited by many environmental factors and the cultivar. Many investigators tried to Increase the productivity of tomato fruits with high quality and good

storability is considered as an important aim that could be achieved through using some bio-stimulants,i.e., effective microorganisms (EM), seaweed extract (SWE) and humic acid (HA) as well as naphthalene acetic acids (NAA), salicylic acid (SA) and monopotassium phosphate (MKP).

Effective microorganism is an organic fertilizer used for soil and foliar application to promote growth and increase yield, and is made from a solution of EM and molasses, usually added to bran or straw and then fermented. It has been shown that the application of EM can improve photosynthetic efficiency and capacity due to an increase in nutrient availability, as well as increase root mass **(Lindani and Bvenura 2012,)**. Use of the microorganisms as soil addition, which should improve physical-chemical and biological properties and increase soil organic matter, cation exchange capacity, available mineral nutrients as environment friendly biofertilizer helps to reduce the use of much expensive phosphatic fertilizers **(Idris*et al.* 2018)**. Worldwide, seaweed-based agricultural products are commonly employed **(Rosalba, 2013)**, in organic or reduced-input cropping systems. Seaweed extract are known as a source of plant growth regulators **(Herrera *et al.*,2014)** organic osmolites, amino acids mineral nutrients, vitamins and vitamin precursors **(Sutharsan*et al.*,2014)**. Seaweed extract as soil conditioning agent it combines with metabolic radicals to form cross-link polymers which increase water holding characteristics of the rhizospherel contributes to create an environment more suitable for the growth of roots and root associated beneficial micro-organisms **Reeta*et al.* (2011)**. Humic acid is a commercial product of organic fertilizers containing most elements that improve soil fertility and increase nutrients availability. Therefore, it enhances plant growth, yield, and decreases the harmful effect of stresses **(Ashraf *et al.*, 2008; Kazemi, 2014 and Farnia and Moradi ,2015)** through improving soil structure and soil microorganisms. It stimulated the plant growth through several mechanisms, i.e. increasing cell division, stimulating the soil microorganisms, optimizing uptake of water and nutrients **(Asri*et al.*, 2015).**

Some of the plant growth regulators included NAA are very effective to increase the fruit set, fruit size, growth as well as yield and quality under low and high temperature environment **(Tiwari and Singh, 2014 and Chauhan*et al.*,2017)**. Salicylic acid is plant hormone phenolic nature that has adverse effects on tolerance to abiotic stresses (**Jayakumar*et al.*, 2006).** Application of salicylic acid induced tolerance in plant to many abiotic and biotic stresses (**Zahra *et al.*, 2010).** Salicylic acid naturally occurs in plants in very low amounts and participates in the regulation of physiological processes in plant such as stomatal closure, nutrient uptake, chlorophyll synthesis, protein synthesis, inhibition of ethylene biosynthesis, transpiration and photosynthesis, early flowering and control the diseases**(Yildirim and Dursun,2009 and El-Mehy and Mohamed ,2018)**.Using environmental friendly products Many authors demonstrated that growth and flowering of many vegetables plants are greatly influenced by different fertilization foliar spray treatments among which monopotassium phosphate MKP(KH_2PO_4) (P_2O_5 : 52 % - K_2O : 34%) overcome the reducing negative effect of high temperature and increased chemical constituents of plant foliage and fruit yield and improve fruit quality indices. MKP is a potential substitute for ammoniated forms of P. This fertilizer has been studied as a foliar nutrient spray (**Chapagain and Wiesman, 2004**). Another potential benefit of MPP has

shown foliar sprays can induce systemic protection against foliar pathogens; such as powdery mildew **(Sajyan*et al.*, 2018)**.

Therefore this study was carried out to investigate the effect of using some environmentally friendly growth stimulating compounds as a soil addition, effective microorganisms (EM), seaweed extract (SWE) and humic acid (HA) and foliar spray with naphthalene acetic acids (NAA), salicylic acid (SA) and monopotassium phosphate (MKP) on growth, chemical composition, yield and its components as well as fruit quality of tomato plants hybrid F1 010 grown under new reclaimed land conditions.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive winter seasons of 2016-2017 and 2017-2018 in private sector farm at ElshikhMasoud Village, Eledwa Center, El-Minia Governorate, to investigate the effect of soil addition of effective microorganisms(EM) humic acid and seaweed extract and the foliar spray with NAA, salicylic acid and monopotassium phosphate as well as their interaction on growth, chemical composition, fruit yield and its quality of tomato plants*(* *Solanumlycopersicum*Mill) cv. Hybrid 010. The soil of the experimental field was sandy in texture with pH 7.92. Physical and chemical characters of the used soil as average of both seasons are shown in Table a. Physical analysis was estimated according to **Jackson (1973)** whereas, chemical analysis was determined according to **Black et al. (1982)**.

Table a: Average mechanical and chemical analyses of the used soil during the two seasons of growth.

Physical analysis		Chemical analysis			
		Cationsmeq/l		Anions meq/l	
Sand	76.37%	Ca^{++}	1.24	$CO3^{--}$	Zero
		Mg^{++}	0.86	$HCO3^{-}$	2.01
Silt	13.51%	Na^{+}	1.91	Cl^{-}	1.53
Clay	10.12 %	K^{+}	0.16	$SO4^{--}$	0.63
Texture class	Sandy				
Soil pH	7.92	Available N	23.9mg/kg		
E.C, dS/m	1.66	Available P	9.62mg/kg		
Organic matter	0.62%	Available K	38.09mg/kg		

The area of the experimental plot was $12m^2$ included one bed each 8 meters in long and 1.5 meter in width. Transplanting was done on one side of ridge at 50 cm apart between transplants. Transplanting was done on 2nd September in both seasons of 2016 and 2017, respectively. All agriculture practices were done as recommended by Ministry of Agriculture for a good production of tomato.

This experiment included 16 treatments resulted from the combination between four soil additions treatments and four spray treatments as follows.

a-Soil addition treatments

1- Effective microorganisms (EM) at 150ml/L.

2- Seaweed extract at 2g/l

3- Hammer as a source of humic acid at 2g./L.
4- The control treatment (without any addition).

b- Foliar spray treatments.
1- NAA at 50ppm.
2- Salicylic acid at 2g/l.
3- Monopotassium phosphate at 2 g/l.
4-The control treatment (spray with distilled water).

Effective microorganisms :- (EM as commercial name) was obtained from Ministry of Agriculture and Land Reclamation it includes: Effective Microorganisms (EM) preparation contains photosynthetic bacteria (*Rhodopseudomonaspalustrus* and *Rhodobacter space*), milk bacteria (*Lactobacillus casei, Streptococcus lactis*), yeast (*Saccharomyces albus* and *Candida utilis*), actinomycetes (*Streptomyces albus* and *Streptomyces griseus*) and moulds (*Aspergillusoryzae* and *Mucomhiemalis*) **Allahverdiyev*et al.* (2011)**.

Double win : is commercial product from Technogreen company's group contain seaweed extract 18%-Organic matter40%- Mg3%- CaO3%.

Hammer :- is commercial product from Union for Agriculture Development(UAD) contain86%soluble potassium humate, 6%k_20 and 8% Moisture .

Sward:- is commercial product from Union for Agriculture Development(UAD) contain Salicylic acid 25% - K_2O 25%.

The soil addition treatments were added beside plants three times starting 7 days after transplanting and every 10 days by intervals. The spray treatments were started after 21 days from transplanting and every 10 days by intervals for three times through the growing season.

A split plot design with three replicates was used in this experiment where the soil addition treatments were distributed in the main plots while the spray treatments were located randomly in the sub plots. The agricultural practices concerning cultivation, fertilization, irrigation, insect and disease control were conducted as commonly followed according to the recommendation of the ministry of Agriculture for the commercial production of tomato.

Data on vegetative growth, yield and its components and chemical fruits characteristics were recorded as follows:

Data recorded:

1. Vegetative growth characteristics.

Three plants were taken from each experimental plot as a representative sample after 50 days from transplanting and the following data were recorded.

Plantlength**,** number of branches/plant, number of leaves/plant, fresh weight/plantand dry weight per plant**:** the three plants were dried in an oven at 70°C for 72 hr until constant weight. The dried plants were weighted and dry weight per plant was calculated.

2. Chemical composition of plant foliage:

a**.** Total chlorophyll**:** reading of the fifth mature leaf from the top of the plant was measured at 60 days from transplanting using Minolta chlorophyll meter SPAD -502 according to **Yadava (1986).**

b. Total Nitrogen%: was determined in the digested dry matter of plant leaves using microkjeldahl method according to **Pregl (1945).**

c. The Phosphorus content: was determined by using spectrophotometer method as described by **John (1970).**

d. The Potassium content**:** was determined by using flame photometer method as described by **Brown and Lilleland (1964).**

e. Total carbohydrates**%:** it was determined in the dry matter samples according to **Herbert *et al.* (1971)**

3. Fruit yield and its components:

At harvest mature fruits were picked along the harvesting season and the following data were recorded,fruit yield/plant: It was calculated form fruit yield/plot and numbers of plants/plot, total fruit yield/fed: It was calculated using plot yield and plot area, marketable fruit yield/fed: it was calculated as weight of harvested fruits after discarding the injured and misshaped fruits and unmarketable yield/fed: it was calculated as weight of discarded the all injured and misshaped fruits.

4. Chemical fruit quality:

a. Total soluble solids (T.S.S.):A random sample of 10 fruits from each experimental plot at full ripe stage was taken to determine the percentage of soluble solid content by using the hand refractmeter.

b. Total titratable acidity (T.T.A): A random sample of 100g of fruit at full ripe stage from each experimental plot was taken to determine T.T.A. of juice by titration with 0.1 N NaOH (Sodium hydroxide) solution using phenolphthalin indicator, according to the method described in **A. O. A.C. (1990).**

c. Ascorbic acid "Vitamin C":It was determined in the same sample taken for acidity measurement using the indicator of 2,6 dichlorophenol indophenol by titration as the method mentioned in **A. O. A. C. (1990).**

d. Total sugars: total sugars were determined in fresh samples of ripe fruits for each experimental plot colormetrically by the method described by **Nelson (1974).**

3.4. Statistical analysis:

All collected data were subjected to statistical analysis according to **Snedecor and Cochran (1991)** where the least significant difference was considered when even possible.

RESULTS AND DISCUSSION

a. Effect of soil addition treatments.

Concerning the effect of soil addition treatments, i.e. effective microorganisms at 150ml/l, seaweed extract at 2g/l and humic acid at 2g/l as well as the control of treatment, it is obvious from data in Table 1 that vegetative growth characteristics were significantly increased when the plant were supplement with all soil addition treatments compared with the control treatment during the both seasons of this study. In this respect, soil addition of seaweed extract at 2g/l beside the plants three times starting 7days after transplanting and every 10 days by intervals during the growing seasons followed by using humic acid at 2g/l during the first season and effective microorganisms at 150ml/l during the second season reflected the highest values of all studied vegetative growth traits. Obtained results are true during both seasons of study. In this concern, the increments in different studied vegetative

growth aspects as a result of using soil addition treatments application may be due to the main role of such substance as natural soil conditioner, increasing soil water holding and fertility holding capacity, chelating the nutrient elements and make it more available to absorption by plant roots, encouraging root growth, source of growth regulators such as cytokinines, gebbraline and oxines, cause the replacement of Ca and Mg instead of Na on the surface of soil particles. Obtained results are in agreement with those reported by **Ashraf *et al.*(2008), Kazemi (2014)andFarnia and Moradi (2015)** they reported that humic acid had an increasing effect on measured vegetative growth parameters. In addition,**Reeta*et al.*(2011), Rosalba (2013), Abo Sedera*et al* (2014) and Abo Sedera*et al.*(2016)** on tomato indicated that seaweed extract significantly increased vegetative growth characteristics of plants. Also, **Lindani and Bvenura (2012) and Idris*et al.* (2018)** in case of effective microorganisms on tomato reported similar results.

b. Effect of foliar spray treatments.

With regard to the effect of foliar spray treatments , the same data in Table 1 indicate also that vegetative growth characteristics of tomato plants expressed as plant length, No. of branches /plant, No. of leaves /plant, fresh and dry weight/plant were significantly increased when the plant were foliar sprayed with each of naphthalene acetic acids at concentration 50ppm, salicylic acid at 0.5g/l and Monopotassium phosphate at 2 g/l three times during the growing season starting after three weeks from transplanting and every two weeks compared with the control treatment during the two seasons of growth, while plant fresh weight during the second season did not reached the level of significance. In this concept, spraying the plants with salicylic acid at 2g/l exhibited the highest values in all measured growth traits followed by NAA at 50ppm in the first season and Monopotassium phosphate at 2 g/l in the second season. This was true during both seasons of this study. In this connection, the positive effect of foliar spray with salicylic acid compared with the other foliar spray treatments and control treatment may be due to salicylic acid was phenolic acid which act as antioxidant and anti-diseases keep the plants more healthy and delaying the senescence and increase resistance of plant to stress which in turn increased plant growth .These results are similar to those reported by **Abou El-Yazied and Mady (2011), Tiwari and Singh (2014), Chauhan*et al.* (2017) and Hossain*et al.* (2018).** on tomato in case of NAA, **Yildirim and Dursun (2009), Zahra *et al.* (2010)and El-Mehy and Mohamed (2018)** in case of salicylic acid and **Chapagain and Wiesman (2004), Abo Sedera*et al.* (2014), Mohamed and Ali (2016) and Sajyan*et al.* (2018)**in case of monopotassium phosphate on tomato reported similar results.

c. Effect of the interaction.

As for the effect of the interaction between some soil addition and foliar spray treatments on vegetative growth characteristics of tomato plants expressed as plant length, No. of branches /plant, No. of leaves /plant, fresh and dry weight/plant, the same data in Table 1 reveal that the highest values in all measured growth traits were recorded as a result of application seaweed extract at 2g/l to the soil combined with foliar spray the plants with salicylic acid at 0.5g/l. Obtained results are true during both 2016/2017 and 2017/2018 seasons of study.

2. Chemical composition of plant foliage.

a. Effect of soil addition treatments

Data in Table 2 show the effect of some soil addition treatments, i.e., addition each of effective microorganisms, seaweed extract and humic acid on chemical composition of tomato plant foliage.as well as the control of treatment. Such data show clearly that chemical constituents of plant foliage i.e., total chlorophyll reading, macro elements (N, P and K percentage) and carbohydrate% were significantly increased with application of all used soil addition treatments compared with the control treatment with all soil addition treatments compared with the control treatment during the both seasons of this study. In this respect, tomato plants treated with seaweed extract at 2g/l reflected the highest values of all determined chemical constituents followed by those treated with humic acid at 2g/l during both seasons of this trail. Such increases in all assayed chemical constituents, i.e., total chlorophyll reading, macro. elements (N, P and K percentage) and carbohydrate as a result of application of some soil addition treatments may be attributed to the application of effective microorganisms makes such macro-elements in the soil more available for plant absorption and consequently increased its accumulation and its content in plant foliage. In addition, such increases in all assayed chemical constituents as a result of soil addition of seaweed extract may be due to the main role of such treatment as soil amendment, increases root growth and its efficiency for absorption to nutrient elements and translocation and accumulations in plant foliage. Obtained results are coincided with those reported by**Lindani and Bvenura (2012) and andIdris*et al.* (2018)**in case of EM**, Ashrf*et al.* (2008)andKazemi (2014)** in case of humic acid and **Abo Sedera*et al.* (2014) and Abo-Sedera*et al.* (2016** in case ofusing seaweed extract..

b. Effect of foliar spray treatments

With regard to the effect of spray treatments, the same data in Table 2 reveal that all measured chemical constituent, i.e., total chlorophyll reading, N%, P%, K% and total carbohydrate% were significantly increased as a result of spraying the plants three times during the growing seasons starting after three weeks from transplanting and every 10days by intervals using NAA at 50ppm, salicylic acid at 2g/l and mono potassium phosphate at 2g/l compared with the unsprayed plants (the control). In this connection, the highest values for all determined chemical constituents were obtained as a result of foliar spray the plants with mono potassium phosphate at 2g/l followed by salicylic acid at 2g/l and naphthalene acetic acids at 50 ppm compared with the control one. Obtained results are true during both seasons of study. The increases in assayed chemical constituents as a result of foliar spray with such tested growth stimulating substances may be attributed to its effect on increasing the vegetative growth in turn increased the capability of plant absorption and assimilation of different chemical constituents. In this connection the superiority of foliar spray with salicylic acid may be attributed to its effect on photosynthetic as simulates through photosynthetic process which in turn effect on the chemical composition of plant foliage and inturn increased plant growth. In this respect,**Abou El-Yazied and Mady(2011), and Hossain*et al.* (2018)** in case of NAA and **Yildirim and Dursun (2009), Zahra *et al.* (2010), Kazemi (2014) and El-Mehy and Mohamed (2018)** in case of salicylic acid. While**Abo Sedera*et al.* (2014), Mohamed and Ali (2016) and Sajyan*et al.* (2018)**in case of monopotassium phosphate reported similar results on tomato crop.

c. Effect of the interaction:

As for the effect of the interaction between soil addition and spray treatments, the same data in Table 2 show clearly that all measured chemical constituent, i.e., total chlorophyll reading, N%, P%, K% and total carbohydrate% were significantly affected as a result of the interaction between soil addition and foliar spray treatments during both 2016/2017 and 2017/2018 seasons of study. In this regard, using seaweed extract at 2g/l combined with spraying the plants with monopotassium phosphate at 2g/l followed by humic acid at 2g/l as soil addition with monopotassium phosphate at 2g/l as foliar spray and seaweed extract soil addition with salicylic acid at 2g/l foliar spray or naphthalene acetic acids at 50ppm foliar spray reflected the highest values for all measured chemical constituents compared with other interaction treatments during both seasons of growth.

3. Fruit yield and its components

a. Effect of soil addition treatments

Data presented in Table 3 show that total produced fruit yield and its components expressed as total yield per plant and total yield per feddan as well as marketable yield and unmarketable yield per feddan were significantly affected as a result as soil addition treatments, i.e., effective microorganisms at 150ml/l, seaweed extract at2g/l and humic acid at2g/l beside the tomato plants three times during the growing season starting 7 days after transplanting and every 10 days by interval compared with the control treatment. Such trend was true during both seasons of study. In this regard, using seaweed extract as soil addition at 2g/l followed by humic acid at 2g/l and effective microorganisms (EM) at 150ml/L exhibited the highest values of total fruit yield and its components except unmarketable fruit yield which gave the lowest values with soil application seaweed extract at 2g/l. Moreover, such increases in total fruit yield and its components as a result of soil addition treatments are connected with increasing the vegetative growth traits (Table, 1) and increasing the chemical constituents of plant foliage (Table, 2) which in turn affect positively on produced yield . Obtained results are similar to those found by **Lindani and Bvenura (2012) and Idris*et al.*(2018)** in case of EM, **Ashraf *et al.* (2008), Kazemi (2014), Farnia and Moradi (2015)** in case of humic acid and **Reeta*et al.* (2011), Abo Sedera*et al.* (2014), Sutharsan*et al.* (2014), and Abo Sedera*et al.* (2016)**in case of seaweed extract.

b. Effect of foliar spray treatments

Concerning the effect of foliar spray treatment on total fruit yield and its components. The same data in Table 3 indicate clearly that total fruit yield and its components (total yield per plant and total yield per feddan as well as marketable yield and unmarketable yield per feddan) were significantly affected as a result of spraying foliar the plants three times during the growing season after 3 week from transplanting and every 10 days by intervals using NAA at 50ppm, salicylic acid at 2g/l and monopotassium phosphate at 2g/l compared with the unsprayed plants (the control). Obtained results are true during the two season of study. In this regard, the highest values of all fruit yield traits except unmarketable fruit yield were obtained as a result of using salicylic acid at 2g/l followed by using Monopotassium phosphate at 2 g/l and NAA at 50ppm. Such increments in total produced fruit yield and its components as a result of spraying the plants with salicylic acid are connected with the improvement of plant vegetative growth parameters (Table, 1), In addition its effect on increasing in chemical constituents, i.e., total

chlorophyll reading and macronutrients (Table,2)which affected plant growth and in turn increased its productivity, also using such tested growth stimulants treatments reduced the infect fruits and consequently decreased the unmarketable produced fruit yield. In this respect, **Tiwari and Singh (2014), Chauhan*et al.* (2017) and Hossain*et al.* (2018) i**n case of NAA and **Yildirim and Dursun (2009), Kazemi (2014)and El-Mehy and Mohamed (2018)**in case of SA while **Chapagain and Wiesman (2004), Mohamed and Ali (2016) and Sajyan*et al.* (2018)** in case of monopotassium phosphate reported similar results.

c. Effect of the interaction

With regard to the effect of the interaction between soil addition and foliar spray treatments on total fruit yield and its components, i.e., total yield per plant and total yield per feddan as well as marketable yield and unmarketable yield per feddan, Such data in table 3 reveal that addition of seaweed extract at 2g/l to the soil combined with spraying the plants three times using salicylic acid at 2g/l reflected the highest values of total produced fruit yield and its components followed by humic acid at 2g/l with salicylic acid at 2g/l, seaweed extract at 2g/l with monopotassium phosphate at 2 g/l and humic acid at 2g/l with monopotassium phosphate at 2 g/l in descending order.

4. Chemical fruit quality

a. Effect of soil addition treatments

Data presented in Table 4 show clearly that there were a significant difference among the studied treatments compared with the control treatment on all assayed chemical fruit quality. In this connection, using seaweed extract at 2g/l through drip irrigation three times during the growing season staring 7days after transplanting and every 10 days by intervals reflected the highest fruit content of TSS%, vitamin C content, total acidity and total sugars content compared with the other studied soil application treatments, followed by humic acid at 2g/l and effective microorganisms at 150ml/l. Obtained results are true during both seasons of growth. Obtained results may be due to the effect of seaweed extract on increasing photosynthetic pigments (Table, 2) and in turn the formation of ingredient constituents used in assimilation of such chemical fruit constituents. Obtained results are in agreement with those reported by**Lindani and Bvenura (2012) and Idris*et al.*(2018)** in case of EM,**Reeta*et al.* (2011), Abo Sedera*et al.* (2014), Sutharsan*et al.* (2014), and Abo Sedera*et al.* (2016)**in case of seaweed extract as well as, **Ashraf *et al.* (2008), Kazemi (2014)and Farnia and Moradi (2015)** in case of humic acid**.**

b. Effect of foliar spray treatments.

With regard to the effect of foliar spray treatments the same data in Table 4 show clearly that there were significant differences among foliar application of naphthalene acetic acids at 50 ppm, salicylic acid at 2g/l and monopotassium phosphate at 2 g/l on all measured chemical fruit quality, i.e., T.S.S.%, vitamin C content, total acidity% and total sugars% during the both seasons of study. In this respect, foliar application of monopotassium phosphate at 2g/l exhibited the highest values in all forementioned fruit chemical parameters compared to the other foliar application treatments and control treatment, followed by using salicylic acid at 2g/l and NAA at 50ppm . Such results are true during both seasons of this study. In this respect, the superiority of mono potassium phosphate may be attributed to its effect on photosynthetic assimilates through photosynthetic process which in turn affect on the chemical composition of fruit. Obtained

results are coincided with those found by **Tiwari and Singh (2014) andChauhan*et al.* (2017)** in case of NAA**, Yildirim and Dursun (2009), Kazemi (2014) and El-Mehy and Mohamed (2018),** in case of salicylic acid and**Chapagain and Wiesman (2004), Abo Sedera*et al.* (2014) and Sajyan*et al.* (2018)** in case of monopotassium phosphate.

c. Effect of the interaction

Referring the effect of the interaction treatments, data in Table 4 show clearly that the total soluble solids, vitamin C content, total acidity % and total sugars concretions in tomato fruits were significantly affected due to the interaction treatments between the tested soil and foliar application with some studied growth stimulates. In this respect, the highest fruit chemical constituents were noticed as a result of the soil addition of seaweed extract at 2g/l combined with spraying the plants with monopotassium phosphate foliar application at 2g/l during both seasons of growth, followed by the same seaweed extract soil application with salicylic acid at 2g/l foliar application, humic acid soil application at 2g/l with MKP foliar spray at 2g/l and seaweed extract soil addition with NAA at 50ppm foliar application at during the two seasons of growth.

Table (1): Effect of some soil addition and foliar spray treatments and their interaction on vegetative growth characteristics of tomato plants during both seasons of study.

Treatments		Season2016/2017					Season2017/2018				
Soil addition	Foliar spray	Plant length (cm)	No. of branches /plant	No. of leaves /plant	Fresh weight (g)/plant	Dry weight (g)/plant	Plant length (cm)	No. of branches /plant	No. of leaves /plant	Fresh weight (g)/plant	Dry weight(g) /plant
Effective microorganisms		118.2	9.87	70.8	1336.6	225.7	125.6	9.5	67.7	1355.8	228.5
Seaweed extract		123.4	10.60	75.5	1428.7	248.9	129.1	10.1	73.3	1416.6	245.1
Humic acid		121.0	10.22	72.5	1360.8	230.6	123.6	9.2	69.4	1339.5	226.7
Control		111.0	9.25	66.7	1272.5	211.7	115.0	8.5	63.8	1268.3	210.9
LSD at 5%		**1.914**	**0.28**	**1.47**	**99.9**	**17.2**	**1.5**	**0.29**	**1.5**	**83.3**	**14.0**
	Naphthalene acetic acids	118.9	10.20	72.0	1345.7	226.2	123.2	9.5	69.0	1336.7	224.9
	Salicylic acid	122.5	10.80	74.3	1413.3	250.3	127.1	10.1	71.5	1357.0	240.1
	Mono potassium phosphate	118.3	9.90	71.8	1356.6	233.4	123.7	9.5	68.7	1363.7	233.4
	Control	113.9	9.10	67.3	1283.3	207.0	118.9	8.2	64.9	1322.9	212.9
LSD at 5%		**1.9**	**0.28**	**1.4**	**99.9**	**17.24**	**1.5**	**0.29**	**1.5**	**83.3**	**14.0**
Effective microorganisms	Naphthalene acetic acids	118.1	10.10	71.6	1315.0	220.0	124.6	9.9	68.2	1328.3	222.6
	Salicylic acid	122.7	10.70	73.4	1395.0	243.5	129.5	10.4	70.5	1338.3	234.6
	Mono potassium phosphate	117.8	9.90	70.9	1360.0	229.2	125.8	9.8	67.3	1411.6	235.1
	Control	114.4	8.80	67.5	1276.7	210.1	121.6	8.2	65.1	1345.0	222.0
Seaweed extract	Naphthalene acetic acids	124.4	10.80	75.8	1398.3	239.7	130.1	10.3	74.2	1361.6	233.2
	Salicylic acid	127.2	11.60	79.5	1536.6	282.1	132.7	11.1	76.9	1480.0	270.7
	Mono potassium phosphate	122.6	10.30	76.3	1453.3	251.5	128.4	10.1	73.8	1470.0	252.3
	Control	119.4	9.90	70.6	1326.6	222.4	125.3	9.2	68.5	1355.0	224.2
Humic acid	Naphthalene acetic acids	121.9	10.50	73.2	1393.3	231.7	123.1	9.4	70.3	1400.0	233.7
	Salicylic acid	125.6	11.10	75.2	1413.3	251.4	127.9	9.8	71.1	1378.3	243.9
	Mono potassium phosphate	120.2	10.20	73.4	1325.0	230.9	124.2	9.7	69.8	1266.6	220.3
	Control	116.5	9.10	68.2	1311.7	208.5	119.3	7.9	66.5	1313.3	209.0
Control	Naphthalene acetic acids	111.3	9.40	67.4	1275.0	213.4	115.3	8.6	63.6	1256.6	209.9

	Salicylic acid	114.7	9.80	69.4	1308.3	224.1	118.6	9.1	67.8	1231.6	211.2
	Mono potassium phosphate	112.6	9.20	66.9	1288.3	222.2	116.7	8.7	64.2	1306.6	225.9
	Control	105.6	8.60	63.2	1218.3	187.1	109.5	7.8	59.7	1278.3	196.4
LSD at 5%		**3.8**	**0.57**	**2.9**	**199.9**	**34.4**	**3.1**	**0.5**	**3.1**	**166.6**	**28.1**

Table (2): Effect of soil addition and foliar spray treatments and their interaction on chemical constituent of plant foliage of tomato plants n during both seasons of study.

Treatments		**Season2016/2017**					**Season2017/2018**				
Soil addition	**Foliar spray**	**Total chlorophyll reading**	**N%**	**P%**	**K%**	**Carbohydrate %**	**Total chlorophyll reading**	**N%**	**P%**	**K%**	**Carbohydrate %**
Effective microorganisms		47.5	2.13	0.34	2.65	10.87	55.9	2.26	0.38	3.00	12.45
Seaweed extract		53.4	2.47	0.40	3.22	13.54	64.95	2.57	0.45	3.41	14.34
Humic acid		50.8	2.27	0.37	3.03	12.62	61.1	2.44	0.41	3.25	13.50
Control		43.3	1.96	0.33	2.43	10.32	51.4	2.08	0.36	2.77	11.17
LSD at 5%		**1.5**	**0.18**	**0.02**	**0.13**	**1.21**	**1.7**	**0.07**	**0.02**	**0.09**	**1.23**
	Naphthalene acetic acids	48.4	2.19	0.35	2.74	11.56	57.7	2.31	0.40	3.08	12.72
	Salicylic acid	49.5	2.21	0.36	2.84	11.92	59.5	2.34	0.40	3.13	12.77
	Mono potassium phosphate	52.4	2.36	0.39	3.10	13.02	63.0	2.48	0.43	3.30	13.85
	Control	44.7	2.08	0.33	2.64	10.86	53.2	2.20	0.38	2.92	12.11
LSD at 5%		**1.5**	**0.18**	**0.02**	**0.131**	**1.21**	**1.7**	**0.07**	**0.02**	**0.09**	**1.23**
Effective microorganisms	**Naphthalene acetic acids**	47.4	2.13	0.34	2.51	10.53	55.6	2.29	0.37	2.99	12.41
	Salicylic acid	48.9	2.14	0.33	2.63	10.83	57.3	2.26	0.38	3.01	12.52
	Mono potassium phosphate	51.3	2.25	0.38	2.97	12.11	59.5	2.38	0.41	3.18	13.26
	Control	42.5	2.02	0.32	2.52	10.02	51.4	2.14	0.37	2.85	11.62
Seaweed extract	**Naphthalene acetic acids**	52.4	2.43	0.40	3.14	13.15	63.5	2.51	0.45	3.38	14.12
	Salicylic acid	53.8	2.49	0.41	3.25	13.72	66.2	2.56	0.44	3.41	14.25
	Mono potassium phosphate	56.6	2.66	0.43	3.47	14.89	70.4	2.75	0.48	3.66	15.38
	Control	50.8	2.31	0.38	3.02	12.42	59.6	2.46	0.43	3.21	13.62
Humic acid	**Naphthalene acetic acids**	50.3	2.21	0.36	2.99	12.46	60.5	2.40	0.42	3.22	13.52
	Salicylic acid	51.1	2.24	0.38	3.07	12.93	61.8	2.45	0.41	3.26	13.37
	Mono potassium phosphate	54.2	2.47	0.41	3.24	13.75	65.8	2.59	0.44	3.43	14.63
	Control	47.9	2.18	0.34	2.83	11.37	56.3	2.32	0.39	3.11	12.48
Control	**Naphthalene acetic acids**	43.7	1.99	0.32	2.35	10.12	51.2	2.07	0.36	3.74	10.84
	Salicylic acid	44.3	1.97	0.33	2.42	10.21	52.7	2.12	0.37	2.68	10.97
	Mono potassium phosphate	47.6	2.06	0.36	2.75	11.34	56.3	2.22	0.39	2.95	12.16
	Control	37.8	1.82	0.31	2.21	9.64	45.7	1.91	0.35	2.53	10.73
LSD at 5%		**3.1**	**0.18**	**0.05**	**0.26**	**2.42**	**3.5**	**0.15**	**0.05**	**0.19**	**2.47**

Table (3): Effect of some soil addition and foliar spray treatments and their interaction on fruit yield and its component of tomato plants during both seasons of study.

Treatments		Season2016/2017				Season2017/2018			
Soil addition	Foliar spray	Total yield (kg) /plant	Total yield (t/ fed.)	Marketable yield(t/ fed.)	Unmarketable yield(t/ fed.)	Total yield (kg) /plant	Total yield (t/ fed.)	Marketable yield(t/ fed.)	Unmarketable yield(t/ fed.)
Effective microorganisms		5.66	31.71	29.39	2.32	5.76	32.28	29.69	2.58
Seaweed extract		5.97	33.44	31.96	1.47	6.25	35.01	33.37	1.64
Humic acid		5.75	32.20	30.37	1.82	6.03	33.81	31.66	2.14
Control		5.45	30.55	27.69	2.86	5.61	31.43	28.21	3.22
LSD at 5%		**0.232**	**1.30**	**1.29**	**0.12**	**0.25**	**1.44**	**1.48**	**0.09**
	Naphthalene acetic acids	5.51	30.94	28.70	2.20	5.87	32.91	30.40	2.50
	Salicylic acid	6.20	34.76	33.15	1.60	6.36	35.64	33.78	1.86
	Mono potassium phosphate	5.89	33.00	31.01	1.98	6.06	33.95	31.64	2.31
	Control	5.22	29.24	26.54	2.69	5.36	30.03	27.11	2.92
LSD at 5%		**0.232**	**1.30**	**1.29**	**0.12**	**0.258**	**1.44**	**1.48**	**0.09**
Effective microorganisms	Naphthalene acetic acids	5.48	30.73	28.40	2.32	5.71	32.02	29.36	2.71
	Salicylic acid	6.02	33.73	31.87	1.86	6.09	34.15	32.05	2.09
	Mono potassium phosphate	5.81	32.55	30.41	2.13	5.88	32.98	30.58	2.39
	Control	5.32	29.83	26.87	2.95	5.35	29.97	26.82	3.14
Seaweed extract	Naphthalene acetic acids	5.69	31.90	30.33	1.57	6.06	33.94	32.18	1.75
	Salicylic acid	6.58	36.84	35.65	1.19	6.88	38.53	37.25	1.27
	Mono potassium phosphate	6.17	34.57	33.24	1.32	6.38	35.76	34.19	1.56
	Control	5.43	30.46	28.63	1.82	5.68	31.83	29.84	1.98
Humic acid	Naphthalene acetic acids	5.46	30.62	28.67	1.95	6.02	33.76	31.54	2.21
	Salicylic acid	6.41	35.94	34.57	1.36	6.47	36.28	34.62	1.65
	Mono potassium phosphate	6.03	33.79	32.06	1.73	6.23	34.94	32.80	2.13
	Control	5.07	28.43	26.19	2.24	5.40	30.26	27.69	2.56
Control	Naphthalene acetic acids	5.41	30.34	27.39	2.95	5.70	31.92	28.59	3.32
	Salicylic acid	5.81	32.55	30.53	2.01	6.00	33.62	31.19	2.42
	Mono potassium phosphate	5.55	31.08	28.35	2.73	5.73	32.14	28.98	3.15
	Control	5.04	28.23	24.49	3.73	5.01	28.07	24.08	3.98
LSD at 5%		**0.46**	**2.61**	**2.58**	**0.24**	0.51	**2.89**	**2.96**	**0.19**

Table (4): Effect of some soil addition and foliar spray treatments and their interaction on chemical fruit quality of tomato fruits during both season of study.

Treatments		Season2016/2017				Season2017/2018			
Soil addition	Foliar spray	T. S. S %	V. C (mg/100 g)	Acidity %	total sugars	T. S. S %	V. C (mg/100 g)	Acidity %	total sugars
Effective microorganisms		5.1	38.25	0.75	3.33	5.4	42.25	0.78	3.62
Seaweed extract		5.8	43.25	0.83	3.69	6.1	46.75	0.87	4.06
Humic acid		5.4	41.00	0.79	3.48	5.6	44.50	0.83	3.84
Control		4.6	34.250	0.68	3.21	5.1	38.00	0.72	3.38
LSD at 5%		**0.24**	**2.333**	**0.02**	**0.09**	**0.28**	**2.32**	**0.02**	**0.06**
	Naphthalene acetic acids	5.1	37.25	0.75	3.37	5.4	41.75	0.79	3.67
	Salicylic acid	5.3	40.25	0.78	3.48	5.6	44.00	0.81	3.74
	Mono potassium phosphate	5.6	44.25	0.82	3.64	5.9	47.25	0.85	3.91
	Control	4.8	35.00	0.70	3.22	5.2	38.50	0.74	3.57
LSD at 5%		**0.24**	**2.33**	**0.02**	**0.09**	**0.27**	**2.32**	**0.02**	**0.06**
Effective microorganisms	Naphthalene acetic acids	5.1	36.00	0.74	3.29	5.2	41.00	0.78	3.54
	Salicylic acid	5.2	40.00	0.77	3.41	5.4	44.00	0.80	3.66
	Mono potassium phosphate	5.5	43.00	0.81	3.54	5.9	46.00	0.83	3.81
	Control	4.8	34.00	0.68	3.11	5.1	38.00	0.72	3.47
Seaweed extract	Naphthalene acetic acids	5.7	41.00	0.82	3.64	6.0	45.00	0.86	3.99
	Salicylic acid	5.9	44.00	0.86	3.73	6.2	47.00	0.89	4.08
	Mono potassium phosphate	6.2	49.00	0.88	3.95	6.4	53.00	0.93	4.26
	Control	5.4	39.00	0.79	3.47	5.8	42.00	0.82	3.92
Humic acid	Naphthalene acetic acids	5.4	39.00	0.79	3.39	5.5	43.00	0.83	3.81
	Salicylic acid	5.5	42.00	0.81	3.54	5.8	46.00	0.84	3.82
	Mono potassium phosphate	5.8	47.00	0.85	3.72	6.1	49.00	0.88	3.97
	Control	5.1	36.00	0.73	3.28	5.3	40.00	0.78	3.76
Control	Naphthalene acetic acids	4.5	33.00	0.68	3.19	5.1	38.00	0.70	3.37
	Salicylic acid	4.7	35.00	0.69	3.25	5.2	39.000	0.72	3.42
	Mono potassium phosphate	5.1	38.00	0.75	3.36	5.5	41.00	0.79	3.63
	Control	4.1	31.00	0.61	3.04	4.8	34.00	0.67	3.13
LSD at 5%		**0.48**	**4.66**	**0.05**	**0.18**	**0.52**	**4.65**	**0.05**	**0.12**

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تاثير الاضافة الارضية والرش ببعض منشطات النمو على نمو وانتاجية الطماطم النامية تحت ظروف الاراضىالمستصلحة الجديدة

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أجريت تجربتين حقليتين خلال الموسم الشتوى لعامي ٢٠١٦-٢٠١٧ و٢٠١٧-٢٠١٨ في مزرعة خاصة بقرية الشيخ مسعود مركز العدوة بمحافظة المنيا لدراسة تأثير الإضافة الارضية للكائنات الحية الدقيقة النافعة (EM) وحامض الهيوميك و مستخلص الطحالب البحرية والرش الورقي بنفثالين حامض الخليك وحمض الساليسيليك وفوسفات احادى البوتاسيوم وكذلك معاملات التفاعل بينهما على النمو الخضرى والتركيب الكيميائي والمحصول الثمرى وصفات الجودة لثمار نباتات الطماطم هجين ٠١٠ وقد أشتلمت الدراسة على ١٦ معاملة ناتجه من التفاعل بين أربعة معاملات للإضافة الأرضية وهي: اضافة الكائنات الحية الدقيقة النافعه (EM) بمعدل ١٥٠ملل/لتر، حمض الهيوميك بمعدل ٢ جرام/لتر ومستخلص الطحالب البحرية بمعدل ٢ جم/ لتر ومعاملة الكنترول (بدون أى اضافة).معاملات الاضافة الارضية تم اضافتها بجوار النباتات ثلاث مرات خلال موسم النمو تبدأ بعد ٧ أيام من الشتل ثم مرة كل عشرة أيام. وأربع معاملات رش إستخدام فيها كل من نفثالين حامض الخليك(NAA) بمعدل ٥٠ جزء في المليونفوسفات أحادى البوتاسيوم بمعدل ٢ جم / لتر والسوارد كمصدر لحمض الساليسيليك بمعدل ٢ جم / لتر بالإضافة إلي معاملة الكنترول (بدون رش) وقد بدأت معاملات الرش بعد ٢١ يوم من الشتل ثم الرش مرة كل ١٠ أيام ثلاث مرات خلال موسم النمو. وقد أتبع في تصميم التجارب نظام القطع المنشقة مرة واحدة حيث وزعت معاملات الإضافة الأرضية في القطع الرئيسية ومعاملات الرش في القطع الفرعية في أربعة مكررات . ويمكن تلخيص أهم النتائج المتحصل عليها فيمايلي:- أن إضافة مستخلص الطحالب البحرية بمعدل ٢ جم / لتر إلى التربة ثلاث مرات خلال موسم النمو تبدأ بعد ٧ أيام من الزراعة وكل ١٠ أيام مع رش النباتات بحمض الساليسيليك بمعدل ٢ جم / لتر ثلاث مرات تبدأ بعد ٢١يوم من الشتل ثم مرة كل ١٠ أيام وذلك للحصول على نمو خضرى جيد ومحصول ثمرى عالى مع أفضل صفات جودة طبيعية وكيماوية.