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The Infuence of Organic Manures and Foliar Spray of Moringa Extract on Growth, Quality and Yield of Tomato

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ABSTRACT

Two field experiments were conducted during 2016/2017 and 2017/2018 growing seasons in the Experimental Farm, Faculty of Agriculture and Natural Resources, Aswan University, Egypt on a sandy textured soil, to assess tomato growth, yield and quality as affected by organic manures and foliar spray of moringa extract. The organic manures treatments were (without manure "control", chicken manure and wastes of sugar factories), at the rate of 20 m^3 per fed. into the staggered rows and buried it in the planting sides (northern side) of the rows. While the applied concentrations of moringa leaves extract were, control distilled water, 20 g/l (M1), and 40 g/l (M2). Each aqueous extract was applied twice after one month from transplanting and two weeks later. The applied experimental design was split-plot system in a randomized complete blocks design with three replicates. The obtained results revealed that all treatments were very effective in stimulating plant height, number of branches per plant, dry weight per plant, total number of fruits per plant, average fruit weight, early yield, total yield, total soluble solids (TSS), ascorbic acid content, NO_3 and NO_2-N concentrations and chemical analyses of leaves plants (N, P and K %). The treatments combination of Chicken manure at 20 m^3/fed. + 40 g/l moringa leaves extract (M2) which showed significant increases in most studied characters followed by treatment (40 g/l of moringa leaves extract + 20 m^3 of wastes of sugar factories/fed.) in both seasons.

Keywords: Tomato, Moringa extract, Chicken manure, wastes of sugar factories, vegetative growth, yield, fruit quality, organic farming, NO_3, NO_2.

INTRODUCTION

Tomato (*Solanum Lycopersicum* L., family Solanaceae) is one of the most important vegetable crops grown all over the world. In Egypt, the total area devoted by this crop was estimated to be 253201 ha., with an average yield of 8,533,803 tons according to FAOSTAT 2015. Among all vegetable crops of Egypt, tomatoes enjoy the highest cropping intensity ratio in land use. Tomato plant can develop below an extensive variety of climatic situations, but extraordinarily touchy to warm and moist developing situations (Ahmed, 2014). It can be grown on different kinds of soil but does best in well drained silt loams or clay loams with a pH of 5.5-6.5 (Sunilkumar and Jaikumaran, 2002; Tiwari *et al.,* 2003). To increase tomato production, several investigations suggested using foliar Moringa extract with different concentrations of the crude extract measured for treatments: 20%, 40%, 60%, 80%, and with 100 %, this indicates that, the Moringa leaf extract used significantly increased the growth and yield of tomato plants in all the trials with erect stemming, fresh leaves, regular branching (Bashir *et al.,* 2014) and (Muhammad Yousaf *et al.,* 2015). Use of organic fertilizer has a beneficial effect on the cultivation of tomatoes, Toor *et al.* (2006), which resulted in a significant increase in yield and number of branches and increased the level of nitrogen, phosphorus and potassium.

Soil quality is a complex characteristic, it is determined by the physical, chemical and biological components of the soil (Manna *et al.,* 2005). Changes in soil physico-chemical and biological characteristics are conceders' good indicators of soil quality. The fact is that soil chemical and biological properties change when soil organic carbon content is increased due to organic amendments (Diacono and Montemurro. 2010; Bouajil and Sana, 2011). In soils, impact of addition of organic amendments on nutrients availability was investigated by several authors (Hou *et al.,* 2012). Organic amendments improved soil structure aggregate stability in soil, as well as its moisture retention capacity by increasing the total number of storage pores (Bhattacharyya *et al.,* 2008). Organic fertilizer is a suitable source of macro- and micronutrient (Taheri *et al.,* 2011). Organic agriculture relies heavily on boosting the level of organic matter in the soil; this is typically achieved by replacing inorganic fertilizers with organic manure as the fertility source of choice and is typically applied to the soil at rates designed to supply a crop's nitrogen requirement and may increase the solubility and availability of P in soils (Evanylo *et al.,* 2008). Manures will maintain soil organic carbon as well as add N and other nutrients to the soils for agronomic crops (Tariberti *et al.,* 2008)

The world has become aware of environmental issue in recent years. Synthetic compounds are highly polluting, hazardous and much more costly.

Researchers work in the field of natural products because they are safe, less dangerous, available and low cost. Increased farmers' use of inorganic fertilizer as a source of plant nutrition is associated with high prices, soil degradation and soil pollutants (Phiri, 2010). There is therefore a permanent and urgent need to look for natural and safe alternatives to plant nutrients and natural growth regulators to protect against diseases and insects . Moringa (*Moringa olifera* L.) belongs to Moringaceae family. It is one of such alternatives, being investigated to ascertain its effect on growth and yield of crops and thus can be promoted among farmers as a possible supplement or substitute to inorganic fertilizers (Phiri, 2010). Moringa leaf extract is a rich source of amino acids, potassium, calcium, iron, vitamin E, ascorbates, phenolic compounds and growth regulating hormones like Zeatin (Makkar and Becker, 1996 and Nagar *et al*., 2006). Thus it possesses the potential promote plant growth; hence it can used as a natural plant growth premotor. Zeatin is the most naturally occurring cytokinin that not only promotes the growth of plants by facilitating cell division and cell elongation as well as its anti-aging potential and protective effects in plants. Moringa leaf extract has been reported to increase the yield of many crops *viz*, major cereals [maize (*Zea mays* L.), rice (*Oryzaesativa* L.), sorghum (*Sorghum bicolor* L.); wheat (*Triticum sativum* L.)] as reported by (Phiri, 2010) and Abbas *et al.*, (2013), tomato (Culver *et al.,* 2012), common bean (*Phaseolus vulgaris* L.) (Rady and Mohamed, 2015) and Roselle (Hassan and Abd El-Samee, 2015).

This trial aimed to improve growth yield and quality of tomato by using organic manure and foliar spray by *Moringa* extract treatments under Aswan conditions.

MATERIALS AND METHODS

Field experiments were conducted for two consecutive winter seasons of 2016/2017 and 2017/2018 at the Experimental Station Farm, Faculty of Agriculture and Natural Resources, Aswan University, Aswan Governorate-Egypt, to improve growth, yield and quality of tomato by using organic manure and foliar spray by *Moringa* extract. Some analytical data of studied soil before cultivation are presented in Table (1).The experimental field was ploughed, pulverized and ridged into 4 meters long and 1.50 meter wide rows and the row surface was carefully leveled. Each experimental plot consisted of three rows, 18 m^2 = 1/233.33fed. The Tomato seedlings (4-5 mature leaves; 45 d) cv. "Super Shahd" were planted in an open field on 25 September 2016 and 2017 respectively on northern side of the rows in hills 50 cm apart within the row. In each hole one plant encouraged it to grow.

Treatments were consisted of two factors i.e.; organic manure source and *Moringa oliefera* extract, were conducted using split-plots system in a randomized complete blocks design with three replicates. The main plots were allocated for organic manure source. The sub-plots were devoted for the *Moringa* extract. Treatments were applied as follows:

a. Organic manure was added at the rate of 20 m^3 per fed. into the staggered rows and buried it in the planting sides (northern side) of the rows. The plots were irrigated after the application of organic manures. Organic treatments were (without manure "control", chicken manure and wastes of sugar factories). The wastes of the sugar factories used were obtained from the sugar factory of Kom Ombo - Aswan Governorate and some analytical data of the tested organic materials are presented in Table (2).

Table 1. Mean of the mechanical and chemical analysis of the soil before cultivation.

Soil property *	Season	
	2016/2017	2017/2018
Physical properties		
Clay (%)	2.89	3.20
Silt (%)	0.00	0.00
Sandy (%)	95.30	94.50
Textural class	Sandy	Sandy
Chemical properties		
Soluble cations in (1:1) soil to water extract mmol/L)		
Ca^{++}	3.06	3.10
Mg^{++}	1.02	1.05
K^{+}	0.80	0.81
Na^{+}	0.73	0.77
Soluble anions in (1:1) soil to water extract(mmol/L)		
CO_3^{--}	0.00	0.00
HCO_3^{-}	7.11	7.20
Cl^{-}	3.41	3.55
SO_4^{--}	0.42	0.45
pH (1:1 soil suspension)	7.61	7.70
EC (dS/cm) at 25°C	0.33	0.32
Available N (mg/kg soil)	128.28	129.00
Available P (mg/kg soil)	7.50	10.10
Available K (mg/kg soil)	177.00	178.00

***The analyses were carried out at Soil Fertility Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt.**

Table 2. Analytical data of the tested organic materials.

Organic materials	O.C %	Total N %	Total P %	Total K %	Fe ppm	Mn ppm	Zn ppm	C/N ratio
Chicken manure	34.5	1.65	0.80	1.23	675	501	134	19:1
Wastes of sugar factories	23.1	1.23	0.62	1.19	984	612	57	18:1

b. Leaves of moringa (*Moringa oleifera* M.) were collected from the Experimental Station Farm, Faculty of Agriculture and Natural Resources, Aswan Univ.. Drain the plant material in an electric oven at a temperature of 70º C for 48 hr. and then grind in a grindery and passed through a 40 mesh screen. To prepare the extracts, 50 g of each ground plant material were macerated in 500 ml distilled water. Solutions were placed in orbital shaker at room temperature for 24 hr. The extracts were filtered using Whatman filter paper No.1 (Dayanada *et. al.,* 2010).

The obtained extracts were diluted order to achieve the concentrations. Treatment concentrations of moringa leaves extract were control (distilled water), 20 g/l (M1) and 40 g/l (M2). Each aqueous extract was applied twice after one month from tomato transplanting and after two weeks later.

Soil fertility was increased after plowing by adding 20% N in the form of NH_4NO_3 (33.5 % N), K in a form K_2SO_4 (48 % k_2O) and 50 % of the P as $Ca(H_2PO_4)_2$ (15.5 % P_2O_5) from the recommended doses for fertilization in accordance with the recommendations of the Agricultural Research Center of Egyptian (ARCE). The remaining quantities of fertilizer were added in the form of N (urea 46.5 % N + ammonium nitrate 33.5 % N), K(48 % K_2O) and P as phosphoric acid (85 % P_2O_5) were added through the drip irrigation system throughout the growth period of plants with other soluble fertilizers such as $Ca(No_3)_2$ (15.5 % Ca), $MgSO_4$ (50 % Mg_2O).

Measurements

1. Vegetative growth characters

At full blooming stage after 60 days from transplanting, five plants from each replicate were taken randomly to measure and record the plant height (cm), number of main branches per plant and dry weight per plant "g". Plant dry weight (g) was dried in an electrical oven at 70° C till the constant weight and then the average dry weight of whole plant foliage was calculated.

2. Yield and its components characters

Total number of fruits per plant were recorded for all pickings, average of fruit weight (g) was calculated according to the following equation (Fruit weight (g) = Total yield/Number of fruits), early yield (ton/fed.) was collected from the sum of the yield of the first four pickings and total yield (ton/fed.) was calculated as the total weight of full ripe fruits per plot.

3. Chemical constituents

The total soluble solids (TSS) in the extracted juice from five fully ripened fruit and using it to measure this character by using the refractometer according to the method of (Cox and Pearson, 1962). Vitamin C (Ascorbic acid) was estimated by the titration with iodide potassium (Ranganna, 1986). On other hands, NO_3 and NO_2-N concentrations were measured in the dry matter of tomato fruits by phenoldisulfonic acid method according to A.O. A.C. (1990).

In addition, to estimate leaves plant contents (%) of nitrogen and phosphorus colorimetrically according to A.O.A.C (1992). Potassium content was measured in plants using flam photometer according to the method by (Jackson, 1973).

Statistical analysis

Analyzed all data statistically by using the MSTAT-C computer software program which prepared by (Bricker, 1991) and used to compare differences between several the means of the various combinations as described by (Duncan, 1965; Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The results, mostly, showed high responses to the main studied factors and their combinations in both trials conducted during 2016-2017 and 2017-2018. The effects of different factors and their combinations were placed under two main headings as follows:

1. **Effect of organic manures and Moringa extract on vegetative growth, chemical constituents of tomato plants, yield and its components.**

The effects of the different organic manure and Moringa extract levels as well as their interactions on vegetative growth and yield characters of tomato plants, during 2016-2017 and 2017-2018 seasons are shown in Tables (3& 4&5) which demonstrated the main and sub effects of both organic manure and Moringa extract levels in both growth seasons on vegetative growth characters (i.e. plant height, number of main branches per plant and dry weight per plant), chemical analyses of leaves plants (N, P and K %) and yield characters (total number of fruits per plant, average of fruit weight, early yield and total yield).

- **Organic manure**

The results declared that applied chicken manure increased all vegetative growth characters (i.e. plant height, No. of main branches/plant and dry weight per plant, chemical analyses of leaves plants (N, P and K %) and yield characters (total No. of fruits/plant, average of fruit weight, early yield and total yield in both seasons, in comparison with wastes of sugar factories. On the other hand, the without manure (control) exhibited the lowest, mean values of all vegetative growth characters, NPK % in plants, yield and yield components during both seasons. These results are in line with those obtained on cucumber by Omori *et al.* (1977), Eissa (1996); on tomato by Alaa El-Din (2000); on squash by Shehata, (2001) and Shehata (2004).

This result could be due the chicken manure was more easily decomposed than other manures particular in sandy soil as reported by (Ismail *et al.,* 1988), may be attributed to increasing meant ration in plant tissues (Opera and Asigobu 1996), and may be due to the microbial biomass of nitrogen, which is the main source of soil nitrogen and can be mineralizable it in soil (Myroled, 1987; Bonde *et al.,* 1988), the supply of natural nutrients and pest control depends largely on the supply of organic matter and biological processes in organic systems(Rigby and Cáceres, 2001).

Table 3. Effect of organic manure and foliar spray with moringa extract and their interaction on vegetative growth of tomato plants during 2016/2017 and 2017/2018 seasons.

Treatments		Plant height (cm)		No. of branches /plant		dry weight / plant (g)	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Organic manure				Effect of organic manure			
Without manure		55.271 c	54.327 c	10.235 c	9.820 c	125.085 c	123.175 c
Chicken manure		82.450 a	80.115 a	15.169 a	14.473 a	139.251 a	138.182 a
Wastes of sugar factories		79.792 b	77.846 b	13.785 b	13.053 b	132.343 b	129.730 b
Moringa extract				Effect of foliar spray with moringa extract			
distilled water		54.421 c	52.662 c	10.061 c	10.121 c	124.451 c	123.480 c
20 g/l (M1)		74.984 b	73.180 b	13.684 b	12.657 b	133.150 b	130.972 b
40 g/l (M2)		78.529 a	76.710 a	14.343 a	12.931 a	133.870 a	132.750 a
Organic manure	Moringa extract			Effect of interaction treatments			
Without manure	distilled water	55.143 i	54.528 i	10.501 i	9.415 i	125.325 i	123.225 i
	20 g/l (M1)	74.384 h	72.718 h	13.991 h	11.231 h	132.442 h	128.550 h
	40 g/l (M2)	79.789 g	75.249 g	14.737 g	11.349 g	133.651 g	129.907 g
Chicken manure	distilled water	81.810 e	79.463 e	15.195 e	13.024 e	140.752 e	138.431 e
	20 g/l(M1)	88.169 c	84.192 c	15.990 c	14.018 c	159.350 c	154.572 c
	40 g/l(M2)	111.068 a	108.534 a	18.421 a	17.984 a	230.252 a	226.810 a
Wastes of sugar factories	distilled water	80.409 f	78.453 f	14.880 f	12.415 f	133.100 f	131.295 f
	20 g/l (M1)	85.140 d	83.771 d	15.598 d	13.870 d	144.245 d	140.540 d
	40 g/l (M2)	91.617 b	89.187 b	16.672 b	14.252 b	161.031 b	157.185 b

The increases in nutrients concentration in leaves of tomato plants grown in the treated soil with organic amendments may be attributed to the effect of organic materials on improving soil physical, chemical and biological properties, which reflected nutrients status. Also, the decomposition of the organic materials in the soil added more available nutrients and liberated the fixed nutrients as a result of the produced organic acids. The superior effect of chicken manure can be attributed to its richness in nutrients (Table 2). In addition, of N, other macronutrients such as S, P and K as well as micronutrients will be more readily available for plant growth. Also organic manure improving soil properties, thus offering suitable nutrients for vigorous vegetative growth, which reflected in the highest dry weight per plant. The results showed that organic manures produced the earliest female flower; this may attribute to higher N and P element in chicken manure and compost (Gordner and Pew, 1979).

- **Moringa extract**

Vegetative growth characters (i.e. plant height, number of main branches per plant and dry weight per plant, chemical analyses of leaves plants (N, P and K %) and yield characters (total number of fruits per plant, average of fruit weight, early yield and total yield significantly and successively increased as the Moringa extract levels increased in both seasons. The highest mean values were obtained from the highest Moringa extract level (40 g/l (M2)). On the contrary, all investigated vegetative growth characters, significantly, decreased with reducing of Moringa

extract level, during both seasons. The lowest mean values of the characters were recorded for untreated plants.

Table 4. Effect of organic manure and foliar spray with moringa extract and their interaction on chemical constituent characters of tomato plants during 2016/2017 and 2017/2018 seasons.

Treatments		N %		P %		K %	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Organic manure		Effect of organic manure					
Without manure		1.350c	1.304c	0.140c	0.118c	1.157b	1.146b
Chicken manure		3.144a	3.125a	0.463a	0.431a	4.519a	4.474a
Wastes of sugar factories		2.920b	2.803b	0.357b	0.325b	4.315a	4.287a
Moringa extract		Effect of foliar spray with moringa extract					
distilled water		1.217c	1.180c	0.116c	0.100c	1.214c	1.157c
20 g/l(M1)		1.801b	1.575b	0.279b	0.261b	2.790b	2.715b
40 g/l(M2)		2.245a	2.153a	0.359a	0.333a	3.617a	3.436a
Organic manure	Moringa extract	Effect of interaction treatments					
	distilled water	1.342 f	1.118e	0.125f	0.105g	1.133g	1.173g
Without manure	20 g/l(M1)	1.713 e	1.224e	0.305e	0.250f	2.843f	2.557f
	40 g/l(M2)	2.153 d	1.861d	0.388d	0.352d	3.517e	3.212e
	distilled water	3.228 c	3.005b	0.430c	0.386c	4.478cd	4.210c
Chicken manure	20 g/l(M1)	3.394 b	3.176 a	0.478 b	0.432 b	4.647 b	4.415 b
	40 g/l(M2)	3.521 a	3.215 a	0.530 a	0.451 a	5.019 a	4.637 a
	distilled water	3.181 c	2.778c	0.384d	0.321e	4.428d	4.012d
Wastes of sugar factories	20 g/l(M1)	3.327 b	3.156 a	0.431 c	0.396 c	4.505 bcd	4.136 c
	40 g/l (M2)	3.377 b	3.145 a	0.490 b	0.449 a	4.603 bc	4.437 b

Table 5. Effect of organic manure and foliar spray with moringa extract and their interaction on yield and its components characters of tomato plants during 2016/2017 and 2017/2018 seasons.

Treatments		Early yield (ton/fed.)		Number of fruit /plant		Average fruit weight (g)		Total yield (ton/fed.)	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Organic manure		Effect of organic manure							
Without manure		1.501c	1.430c	17.235c	16.855c	100.247c	99.540c	9.215c	8.948c
Chicken manure		2.570a	2.366a	19.952a	19.101a	153.783a	150.950a	16.364a	15.378a
Wastes of sugar factories		2.230b	2.120b	18.673b	18.124b	149.892b	148.470b	14.928b	14.351b
Moringa extract		Effect of foliar spray with moringa extract							
distilled water		1.472c	1.360c	17.695c	16.631c	99.155 c	96.875 c	9.358c	8.593c
20 g/l (M1)		2.075b	1.930b	20.910b	19.325b	151.007b	131.993b	16.840b	13.604b
40 g/l (M2)		2.315a	2.227a	21.941a	21.052a	160.540a	157.190a	18.786a	17.649a
Organic manure	Moringa extract	Effect of interaction treatments							
	distilled water	1.405 f	1.054 g	17.147 h	16.214 g	100.719 i	98.960 i	9.211 i	8.558 i
Without manure	20 g/l(M1)	2.145 e	1.814 f	20.876 e	20.080 d	149.066 h	134.583 h	16.597 h	14.413 h
	40 g/l(M2)	2.274 d	2.042 d	21.745 d	20.974 d	163.747 d	160.067 d	18.990 d	17.905 d
	Without	2.743 c	2.273 c	20.152 f	19.932 e	154.153 f	152.001 f	16.568 f	16.158 f
Chicken manure	20 g/l(M1)	3.119 b	2.757 b	23.359 c	22.837 c	169.899 c	167.571 c	21.166 c	20.410 c
	40 g/l(M2)	3.853 a	3.202 a	26.404 a	25.989 a	180.334 a	178.783 a	25.395 a	24.781 a
	distilled water	2.153 e	1.818 ef	19.957 g	18.921 f	152.213 g	149.594 g	16.2011 g	15.096 g
wastes of sugar factories	20 g/l(M1)	2.377 d	1.947de	22.588 d	20.978 d	158.102 e	155.986 e	19.046 e	17.452 e
	40 g/l(M2)	2.572 c	2.273 c	23.877 b	23.644 b	172.785 b	170.672 b	22.003 b	21.522 e

Almost, similar results were reported by Mona (2013) which explained that the treated of *rocket (Eruca vesicaria subsp. sativa)* with *Moringa extract* is likely to have increased the content of leaves with N, P and K. Whereas, the resulted on yield are agreement with those obtained by Azra, (2011) found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5 % increased crop characteristics, Mvumi Culver *et al.* (2012) and Bashir *et al.,* (2014) on tomato.

The significant increase in the concentrations of N, P and K in the leaves of tomato plants may be due to the significant and important role of Moringa leaf extract, which contains the following compounds such as amino acids, proteins and phenols, mixed with growth hormone " Zeatin" and many minerals as Ca, Mg, Na, Fe, P, K, and many flavonoids as indicated by (Siddhuraju and Becker, 2003; Nagar *et al.,* 2006 and Anwar *et al.,* 2007).

The effective role of the Moringa leaves extract probably due to the higher content of Zeatin.

It is the most common form of natural cytokinin in plants. Zeatin plays an important role in the process of division and elongation of plant cells, which led to the strengthening of growth and anti-aging cells and the effects of protection in the plant. In addition, to containing Moringa extract on proteins and vitamins (A, B, C and E), β carotene, amino acids phenolic sugars, and many minerals (i.e. Ca, Mg, Na, Fe, P and K) and a lot of flavonoid pigments.

Ascorbic acid improved growth and yield of diverse crops (Jyotsna and Srivastava 1998; Fuglie 2000; Foidl *et al*., 2001 and Nagar *et al.*, 2006). In addition, both Ca and K play an effective and essential role in increasing the growth of the plant and providing it through the osmoregulation, enzyme activation, photosynthesis, and other physiological processes, according to the decision (Hasegawa *et al.,* 2000; Epstein and Bloom 2005) and being a great source of natural antioxidants as reported by (Anwar *et al.,* 2007; Jacob and Shenbagaraman, 2011). More than, that the Moringa extract is effective in promoting plant growth which support it for the use as a natural enhancer for plant growth.

- **Interactions effects of organic manures and Moringa extract**

Interaction between organic manures and foliar spray Moringa extract are presented on Tables (3 & 4&5) on vegetative growth characters (i.e. plant height, number of main branches per plant and dry weight per plant, chemical analyses of leaves plants (N, P and K %) and yield characters (total number of fruits per plant, average of fruit weight, early yield and total yield in both seasons.

All investigated vegetative growth parameters exhibited significant increments due to the successive increase of the organic manure, at each Moringa extract level. Obviously, the combination of (chicken manure + 40 g/l Moringa (M2)) extract gave rise to the highest significant mean values of all vegetative growth, NPK % and yield traits, in both seasons. On the other hand, the lowest mean values were obtained from untreated plants in both seasons.

2. Effect of organic manures and Moringa extract on Yield quality

Tables (5&6) displayed that total soluble solids (TSS), Vitamin C (Ascorbic acid) and NO3 and NO2-N concentrations of tomato plants influenced by organic manure and Moringa extract levels during 2016/2017 and 2017/2018 growth seasons.

- **Organic manure**

Results in Tables (6) showed that organic manure had profound and significant effects on some fruit quality of tomato plants characters in both growing seasons. Application of chicken manure accompanied by successive and significant increases in total soluble solids (TSS), Vitamin C (Ascorbic acid), but successive and significant decreases in the NO3 and NO2-N percentages on fruits in both seasons as compared with the control treated with the recommended chemical fertilizer. These results are agreement with those obtained by Alaa El-Den (2000) on tomato and Shehata (2004) on squash.

Application of organic manure decreased NO3 and NO2-N, which agreed with that obtained on tomato by Yamada and Kamata (1989) and on squash by Shehata (2004).

Organic manure application and plowed it in the soil caused distinctly increase available N through its decomposition into NH2, NH4 finally NO3. Whereas, the low NO3 and NO2 percentage in tomato plant tissues may be due to high NH2 and NH4 contents in organic manures which need some time to be converted to NO3 after nitrification. Gordner and Pew (1979) suggested that the slower nitrification rate with the sources containing NH4-N was considered to be the cause for the initially lower NO3-N level, Gobal (1980) pointed out that the lowest values of NO3-N in plants supplied with NH4-N sources may be due to NH4 is used directly in N- assimilation in plant tissues, however NO3 must be reduced at first to NH4 by nitrate reductase enzymes in plants.

- **Moringa extract**

The results in Table (6) showed that foliar spraying of tomato plants with the highest concentration of Moringa leaves extract showed positive and moral effects on fruit quality characteristics in both study seasons.The results showed that the increase in the level of Moringa extract from 0, 20 and 40 g/l resulted in large and gradual increases in total soluble solids (TSS), vitamin C (Ascorbic acid), on the other hand, these treatments led to a significant decrease in the NO3 and NO2-N percentages in both seasons. These effects in fruits quality may be due to the extract of Moringa leaves is a great source of natural antioxidants as reported by (Anwar *et al*., 2007; Jacob and Shenbagaraman, 2011).

Table 6. Effect of organic manure and foliar spray with moringa extract and their interaction on yield quality characters of tomato plants during 2016/2017 and 2017/2018 seasons.

Treatments		Total soluble solids (TSS)		Ascorbic acid %		NO_3 mg/ kg fruit		NO_2 mg/kg fruit	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Organic manure					Effect of organic manure				
Without manure		3.236 c	3.205 b	0.530 c	0.501 b	487.900a	451.180a	5.210a	4.744a
Chicken manure		4.317 a	4.221 a	1.176 a	1.126 a	315.040b	327.463b	3.361b	3.275b
wastes of sugar factories		3.871 b	3.805 b	0.935 b	0.927 a	300.279c	275.623c	3.103c	2.937c
Moringa extract					Effect of foliar spray with moringa extract				
distilled water		3.125 c	3.237 b	0.493 b	0.486 b	513.150 a	493.017a	4.850a	4.925a
20 g/l (M1)		3.901 b	3.860 b	1.117 a	1.120 a	105.130c	100.750c	1.074c	97.145c
40 g/l (M2)		4.487 a	4.535 a	1.175 a	1.133 a	127.282b	115.692b	1.152b	1.173b
Organic manure	Moringa extract				Effect of interaction treatments				
Without manure	distilled water	3.206 g	3.122 h	0.525 g	0.458 f	529.150 a	510.581a	5.135a	4.828a
	20 g/l(M1)	4.127 e f	4.005 f	1.050 f	0.990 e	100.211i	96.470i	1.105 h	1.125i
	40 g/l(M2)	4.649 c	4.436 d	1.219 e	1.127 d	119.261h	110.392h	1.201g	1.186h
Chicken manure	Without	4.264 d e	4.173 e	1.143 e f	1.002 e	249.240f	238.690f	2.391e	2.296f
	20 g/l(M1)	5.834 a	5.639 b	1.632 c	1.273 c	280.155d	266.441d	2.702c	2.590c
	40 g/l(M2)	5.984 a	5.824 a	2.067 a	1.834 a	291.002b	276.900b	2.733b	2.627b
wastes of sugar factories	distilled water	4.010 f	3.895 g	1.05 9 f	0.951 e	221.350g	200.495g	2.115f	2.103g
	20 g/l(M1)	4.384 d	4.147 e	1.431 d	1.134 d	276.170e	254.125e	2.671d	2.486e
	40 g/l(M2)	4.998 b	4.765 c	1.787 b	1.420 b	282.220c	265.827c	2.703c	2.518d

Green leaves of *Moringa oleifera* also content sugars, vitamins (such as A, B, C and E), Beta- carotene, proteins, amino acids and phenolic compounds (Jyotsna and Srivastava 1998; Fuglie, 2000; Foidl *et al.,* 2001 and Nagar *et al.,* 2006) these compounds may have led to a significant increase in fruit quality.

- **Interactions effects of organic manures and Moringa extract**

Tomato plants which are sprayed with 40 g/l Moringa (M2) combined with chicken manure gave the highest fruits content of total soluble solids (TSS) and Vitamin C (Ascorbic acid) in both seasons. On the other hand, both NO_3 and NO_2 concentrations in plant tissues successive and significant decreases in both season compared with control.

Nitrate accumulations in edible plant is considered hazardous to human health. Wright and Davison (1964), and Craddock (1983) pointed out that NO_3 may harm the health of the consumer as it can be converted to NO_2. This NO_2 oxidizes iron in hemoglobin from active ferrous form to the ferric state yielding methemoglobin, which cannot transport O_2.

CONCLUSION

The obtained results, generally, showed that the treatment combination of 40 g/l. Moringa extract as foliar spray plus chicken manure at 20 m^3 /fed.; resulted in the highest average values and might be considered as a optimal treatment for the production of high yield and good quality of tomato plants "Super Shahd" cv. under the environmental conditions of Aswan governorate and other similar regions. Generally, it is concluded that Moringa leaf extracts can be recommended (as other natural materials) to be used very efficiently by farmers to spray as natural plant extracts source

for all crops because they have high nutritional value and antioxidant effects and they are easy to prepare and we can say that they are environmentally friendly compounds.

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دراسة تاثير التسميد العضوى والرش الورقى بمستخلص المورينجا على النمو والجودة والمحصول فى الطماطم منى نمر شحاتة

قسم البساتين–كلية الزراعة والموارد الطبيعية – جامعة اسوان

اجريت هذه الدراسة بمحطة تجارب كلية الزراعة والموارد الطبيعية جامعة اسوان خلال موسمى2016/2017-2017/2018. لدراسة تأثير التسميد العضوى والرش الورقى بالمستخلص المائى لنبات المورينجا على بعض صفات النموالخضرى، وصفات الجودة للثمارلنباتات الطماطم النامية فى تربة رملية تحت ظروف محافظة اسوان. وقد اشتملت التجربة على معاملات التسميد العضوى بمعدل 20 متر مكعب/فدان (بدون اضافة – زرق الدواجن – مخلفات مصنع السكر)، والرش بالمستخلص المائى لأوراق نبات المورينجا بتركيزات (صفر، 20 ، 40 جم/لتر) مرتين الاولى بعد شهر من الشتل والثانية بعد اسبوعين من الاولى، واستخدم فى هذه التجربة تصميم القطع المنشقة لثلاث مكررات، اظهرت النتائج استجابة معنوية لكل الصفات السابقة، حيث اظهرت جميع الصفات زيادة معنوية مع زيادة تركيز المستخلص المائى لأوراق نبات المورينجا الى 40 جم/لتر فى حين اظهرت المعاملة 20 جم/لتر من مستخلص اوراق المورينجا اقل القيم لتركيز النترات والنيتريت بالثمار بالمقارنة بالكنترول، بينما ادى استخدام الاسمدة العضوية المختلفة الى حدوث زيادة معنوية فى متوسط قيم صفات النمو الخضرى والصفات المحصولية وصفات الجودة للثمار"المواد الصلبة الكلية - فيتامين سى"حامض الاسكوربك" و% لمحتوى اوراق النبات من (النيتروجين - الفوسفور - البوتاسيوم) ،وقد جاءت المعاملة بزرق الدواجن فى المرتبة الاولى وتلاها المعاملة بمخلفات مصنع السكر وتشير النتائج الى انخفاض تركيز النترات والنتريت في الثمار مع المعاملة بمخلفات مصنع السكر فى كلا الموسمين بالمقارنة بالكنترول. وعموما أدى التداخل بين المعاملات الى الحصول على أفضل النتائج فى معظم الصفات الخضرية والمحصولية وصفات الجودة وكان افضلها المعاملة (40 جم/لتر من مستخلص اوراق المورينجا +20 متر مكعب زرق الدواجن/فدان) وتلاها المعاملة (40 جم/لتر من مستخلص اوراق المورينجا + 20 متر مكعب مخلفات مصنع السكر/فدان) فى كلا الموسمين، في حين اظهرت المعاملة "بدون اضافة مخلفات عضوية + 20 جم/لتر من مستخلص اوراق المورينجا" اقل تركيز للنترات والنيتريت بالثمار فى كلا الموسمين.