Effect of Compost Tea or some Botanical Extracts on the Fruit Quality of Pomegranate Trees at Upper Egypt

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ABSTRACT

This investigation was carried out during 2019 and 2020 seasons on seven-years-old Manfalouty pomegranate (Punica granatum L.) trees grown in a private orchard located at An Nikhaylah, Abu Tij, Assiut Governorate, Egypt to study the effect of compost tea or botanical extracts of licorice root, garlic cloves and moringa leaves foliar spray as natural growth stimulants on manfalouty pomegranate trees. Results revealed that all treatments significantly increased the qualities and quantities of fruit traits. But it is preferred, under Upper Egypt conditions to Spray 10% compost tea or 1.5% moringa extracts for improving fruit weight, chemical characteristics and productivity whilst spraying 0.5% licorice root extract is preferred to obtain the highest fruit size, in addition to garlic cloves extract (1%) which is preferred for reducing the fruit acidity %.

Key words: Pomegranate, Compost tea, Moringa extract. Garlic extract, Licorice extrac,

INTRODUCTION

Pomegranate (Punica granatum L.) is one of the ancient and highly praised favorite fruit of Mediterranean, tropical and subtropical regions of the world. In modern terminology, compost tea (compost extract) produced from the fermented compost in water (Litterick *et al*., 2004) has been utilized in agriculture as a good source of organic matter and soil amendment that provide plants with mineral nutrients (Abbasi *et al*., 2002). Moreover, it is very rich in growth regulators and phytohormones which stimulates the microorganisms that have a beneficial effect on plant, improves soil physical and chemical properties and suppress some plant diseases pathogen (Biocycle, 2004). However, Bayoumi and Hafez (2006) stated that compost tea significantly increased all growth parameters, chlorophyll content, yield and its quality as compared with recommended dose of nitrogen. Recent studies pointed out to the possibility of using some plant extracts such as licorice root and moringa leaves extracts to enhance growth and yield of plants (Aldroush, 1976 and Nasira et al., 2016). Licorice root contains many of chemical compounds such as gleserezin, glycyrrhejel and licorice acid and vlavonideh. Licorice extract had stimulating effect similar to that of growth regulators on vegetative and flowering characteristics (Alajaili, 2005). Moreover, Moses *et al*. (2002) added that it contained a wide range of elements and nutrients. Recta and Bhatnager (2011) also confirmed that licorice extract can decrease transpiration rate, maintaining cell fullness and reducing water loss due to transpiration. This behavior is because the licorice extract contains sugars and gum substances that increase the percentage of total soluble solids in plant cells and water retaining due to presence of iron and magnesium. Abou-Hussein *et al*. (2000) stated that licorice increases the effectiveness of cellulose enzyme which is important in the lateral expansion of cells results in accelerating the plant growth. In addition, Hussein (2008) found that spraying date palm with licorice extract at 5g/L. enhanced the fruit quality. Sheren and Eman (2015) found that spraying pear with licorice extracts gave the highest values of fruit quality parameters. Likewise, garlic (*Allium sativum*) cloves extract contains enzymes and more than 200 chemical compounds, some of its volatiles are more important *i.e*. allicin that gives garlic its antibiotic properties. Its higher contents of volatile and sulphur compounds put both in the top due to their real and essential roles they play in fruiting process of various fruit trees (Bruneton, 2001). Garlic also contains vitamins, minerals, flavonoids, ascorbic acid, sulphur and trace of iodine. Abd El-Hamied and El-Amary (2015) and El-Sharony *et al*. (2015) reported that garlic extract showed comparatively greater efficacy on nutrition and hormonal status of pear and mango respectively. Likewise, foliar spraying of moringa leaf extract increased the strength of growth, ability to resistant to adverse environmental conditions, delaying fruit aging, improves quality and quantity of yield (Nasira *et al*., 2016). In addition, *Moringa oleifera* contains seven times more vitamin C than orange, ten times vitamin A than carrot, seventeen times Ca than milk, fifteenth times K than bananas, twenty five times Fe than spinach and nine times proteins than yogurt (Fuglie, 2000). Also, plants contain amino acids, fatty acids, phenolics and its leaves contain high zeatin and cytokinin (Barciszweski, *et al.*, 2000 and Farooq *et al.*, 2007). Thus, the aim of this study was to evaluate the effect of spraying by compost tea, Moringa leaf, garlic cloves and licorice roots extracts on some of the qualitative and quantitative characteristics of the fruits of pomegranate yield cv. Manfalouty.

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MATERIALS AND METHODS

This study was carried out during 2019 and 2020 growing seasons on seven-year-old Manfalouty Pomegranate (*Punica granatum* L.) trees grown in a private orchard located at An Nikhaylah, Abu Tij, Assiut Governorate, Egypt. All experimental trees were selected for their uniformity in growth, size, vigor and fruiting habits which planted at 5×5 meters apart. Also, all trees received the ordinary management practices usually applied in the pomegranate orchard, including irrigation, pest control, hoeing and fertilization. Treatments were the spraying with compost tea and botanical extracts of licorice root, garlic cloves and moringa leaves as natural growth stimulants. The experiment was arranged in a randomized complete block design with four replicates as follows:

- Control: spraying with distilled water as a control treatment,
- 10% compost tea extract
- 0.5% licorice root extract
- 1% garlic cloves extract
- 1.5% Moringa leaves extract

The experiment conditions were:

1. **All treatments were applied at the rate of one litter per tree**
2. The extracts were applied in three dates: the first spraying was before flowering on late week of April, with two months interval (last week of April, June and August).
3. All common agricultural practices for pomegranate tree were applied according to the recommendation of the Egyptian Ministry of Agriculture and Land Reclamation.
4. Some constituent's analysis of soil, compost tea, licorice roots, garlic cloves and moringa leaves are shown in Tables 1a, 1b, 1c, 1d and 1e, respectively. However, the physical and chemical analysis of the experimental soil was carried out according to Page *et al.* (1982).

Preparing the extracts was carried out prior the begging of each spraying time. The procedure of preparing the extracts can be described as follows:

Compost tea extract (C-tea):

Compost tea extract (Table 1b) was prepared by the method described by Al-Fartusy (2003) by dissolving a certain weight of the compost in distilled water (weight/volume) and left in plastic containers for 24 hours, then shaked well and put through a 0.64 cm sieve to remove any unnecessary large fragments.

Licorice Roots Extract (L. Extr.):

The aqueous extract (Table 1c) of licorice roots (*Glycyrrhiza glabra*) was prepared by boiling 5 g D.M in one liter of distilled water for 15 minutes. The solution filtered using a cotton cloth, and re-filtered through Whatman filter paper No. 12 and completed by distilled water to one liter.

Garlic extract (Gar. Ext.):

The 1% garlic aqueous extract (Table 1d) was prepared by blending 10 g of fresh mature cloves in one liter of distilled water, frozen and thawed two times, and then filtered and diluted by distilled water to one liter (El-Desouky et al., 1998).

Moringa extract

Leaves powder of *Moringa oleife*ra (Table 1e) was obtained from the unit of moringa production at National Research Center, Giza, Egypt and different concentrations of aqueous extracts were prepared by blending 15g leaves powder in one liter water and left for one hour. The obtained suspension homogenized and filtered using a cotton cloth. Finally, the solution re-filtered using Whatman filter paper No. 2 and rose to one liter (Hossain *et al., 2012).*

Table 1a. Some physical and chemical properties of the experimental soil

Soil Texture	EC dS/m	pH	Elements in soil								
			P %	Na^+ %	K^+ %	Ca^{++} (meq/L)	Mg^{++} (meq/L)	CO_3	HCO_3^- (meq/L)	SO_4^{--}	Cl^-
Clayey	1.21	8.1	0.63	3.98	0.61	23.08	7.54	-	3.14	15.92	22.992

Table 1b. The physicochemical properties of organic compost of tea (Sheren *et al*., 2017)

EC (dS/m)	Ph	N ppm	P ppm	K ppm	Ca ppm	Mg ppm	Fe ppm	Zn ppm
0.812	6.55	251	7.5	212	85	119	64	7.1

Table 1c. Extracted components of licorice root extract (Sheren *et al., 2017)*

Reducing sugar (%)	Non-reducing sugar (%)	Starch (%)	Glycyrrhizic acid (%)	Humidity (%)	GA3 (%)
3.23	10.27	4.76	26	5.88	0.63
P (mg/g)	K (mg/g)	Ca (mg/g)	Mg (mg/g)	Fe (mg/g)	Zn (mg/g)
540	1235	560	280	33	3.6
Antioxidants mg/100g dry weight basis					
Total phenols	**Total flavonoids**	**Saponins**	**Carotenoids**	**Vitamin C**	**Tannins**
405.02	114.91	27.99	11.78	1.2	47.54

Table 1d. Extracted components of garlic cloves according to El-Merghany *et al. (*2019)

GA3 (mg/l00g F.W)	Ca (%)	Mn (ppm)	S04 (%)	Mg (%)	Zn (ppm)
1.633	1.363	94.4	0.181	1.23	66.5

Table 1e. Chemical extracted components of moringa leaves (Moyo *et al.*, 2011)

Components	Ca	P	K	Mg	S%
Value	3.65 %	0.3 %	1.5 %	0.5 %	0.63 %
Components	**Zn**	**Mn**	**Fe**	**Se**	**Cu**
Value	13.03 mg/kg	86.8 mg/kg	490 mg/kg	363 mg/kg	8.25 %
Components	**Crude protein%**	**No of amino acids**	**β-Carotene**	**Vitamin-E**	**Total polyphenols**
Value	30.3 %	19	18.5 mg/100g	77 mg/100g	2.02 %

Recorded data (M. Ext.):

Fruits of each treatment were harvested in the first of October of both seasons, to determine the yield/tree. Ten fruits were randomly taken from each replicate to study both physical and chemical fruit properties. The average fruit length (cm), width (cm) and weight (g), pulp (%), juice (%), yield (kg/tree) and fruit cracking percentage were calculated. Chemical characteristics such as total soluble solids (TSS), reducing sugars, vitamin C content (ascorbic acid/100 ml juice) and acidity (%), were determined following the methods by A.O.A.C (2000). Total anthocyanin content of juice was determined according to Rabino and Mancinelli (1986). Hydrolysable tannin content of juice was estimated according to Cam and Hisil (2010). To determine leaf mineral content (N, P, K, Ca and Mg), leaf samples were taken at the end of experiment. Each sample was collected randomly at a constant height and at all directions of the tree. Total NPK were colorimetrically determined as described by Cottenie *et al*. (1982).

Statistical analysis:

The obtained data were statistically analyzed according to Gomez and Gomez (1984) using LSD test at 5% level for distinguishing the significant differences between various treatment means.

RESULTS AND DISCUSSION

Fruit length, fruit width and fruit weight

Table 2 and Fig.1 showed that each length, width and weight of fruit were significantly affected by compost tea, licorice, garlic and moringa extracts treatments in both seasons. However, licorice extract gave the highest fruit length (9.375 and 9.075 cm) and width (10.275 and 9.475 cm) in the first and the second seasons, respectively. This increase may be due to the effect of licorice extract which contain many various important compounds such as *Triterpene saponins* (including glycyrrhizin), mevalonic acid which is the initiator in the synthesis of gibberellins in plants, polysaccharides, vitamins, and many minerals which play an important role in the growth of plant (Shibata 2000 and Zadeh *et al.*2013). Furthermore, compost tea spraying produced the highest fruit weight in both seasons with no significant differences between compost tea and moringa extract treatments in the 1st

Table 2. Length, width and weight of Manfalouty fruit as affected by treatment by compost tea or some botanical extracts during 2019 and 2020 growing seasons

Treatment	2019			2020		
	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)
Control	7.985	8.79	380.85	7.745	8.165	375.05
C-tea	9.205	10	458.4	8.91	9.245	448.3
L-ext.	9.375	10.275	451.55	9.075	9.475	435.65
G-ext.	9.065	9.975	429.35	8.81	9.3	428.85
M-ext.	9.035	9.95	455.95	8.78	9.25	442.6
LSD	0.163	0.237	5.571	0.159	0.164	5.441

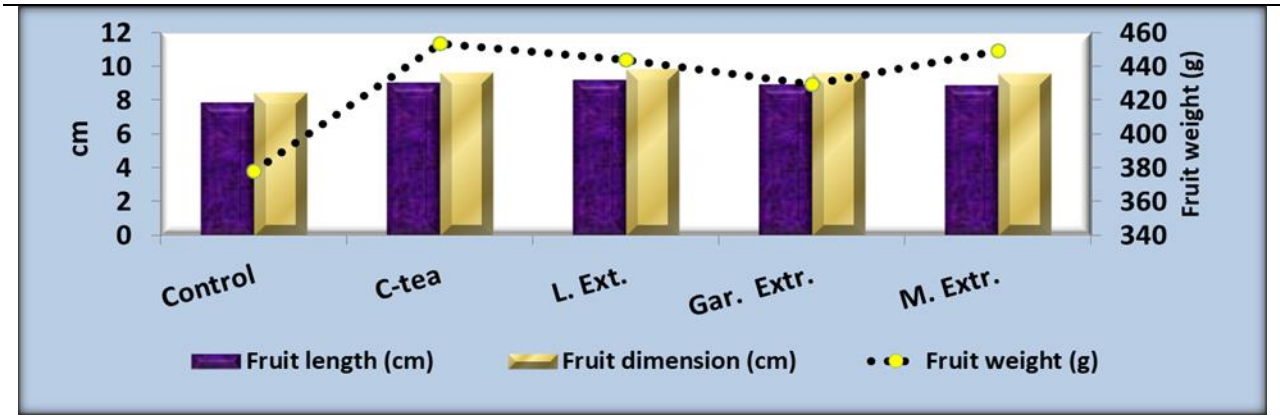

Fig.1. Length, width and weight of Manfalouty fruit as affected by compost tea and some botanical extracts (average of both seasons)

season. In addition, the control recorded the lowest fruit length, fruit width and fruit weight in both seasons.

Table 3 and Fig.2 showed that anthocyanin, pulp % and yield kg/tree were significantly affected by compost tea, licorice, garlic and moringa extracts treatments in both seasons. Both 1.5% moringa leaves and 1% garlic extracts treatments recorded the highest values of anthocyanin (63.55 and 64.89 mg/100g) and (61.76 and 65.51 mg/100g) with no significant differences between them against the control treatment (55.21 and 57.05 mg/100g) in 2019 and 2020 seasons, respectively. Using natural extracts such as *moringa* and garlic helps in availability of minerals and may be capable for producing growth regulating like auxins, cytokinins, GA or vitamins and the earlier reports indicated that plant growth hormone in small amounts modified a given physiological process and rarely acted alone as the action of two or more are necessary to produce a physiological effect (Hafez et al., 2013, Mona, 2001 and Vagner et al., 2003). Furthermore, compost tea recorded the highest pulp percentage and yield/tree at both seasons and 2nd one, respectively with no significant differences were obtained between compost tea and moringa extract for pulp % (1st season) and yield/tree (both seasons). Accordingly, compost tea proved to be the most efficient in enhancing tree fruiting of Manfalouty trees hence it increased fruit weight, fruit pulp percentage and improved tree yield (yield Kg/tree). Such findings could be explained on the basis of the beneficial effect of compost tea as it contains enough values of macro, micronutrients and has high useful amount of needed bacteria, fungi and actinomycetes. The present results are in agreement with those of Abdou (2010) working on “Le-Conte” pear, Shaaban, *et al*. (2011) on "Anna" apple and Aly (2012) on “Costata” persimmon who studied different fertilization methods.

Table 3. Anthocyanin (mg/100g), pulp (%) and yield kg/tree of Manfalouty as affected by compost tea and some botanical extracts during 2019 and 2020

Treatment	2019			2020		
	Anthocyanin (mg/100g)	Pulp (%)	yield kg/tree	Anthocyanin (mg/100g)	Pulp (%)	yield kg/tree
Control	55.21	59.465	83.065	57.045	58.17	95.08
C-tea	57.21	65.375	100.265	61.59	64.325	111.785
L-ext.	56.945	64.075	99.275	60.265	63.619	102.62
G-ext.	61.755	62.25	98.59	65.505	62.315	101.97
M-ext.	63.55	64.555	100.6	64.89	63.225	108.975
LSD	2.01	1.163	1.32	1.842	0.625	2.831

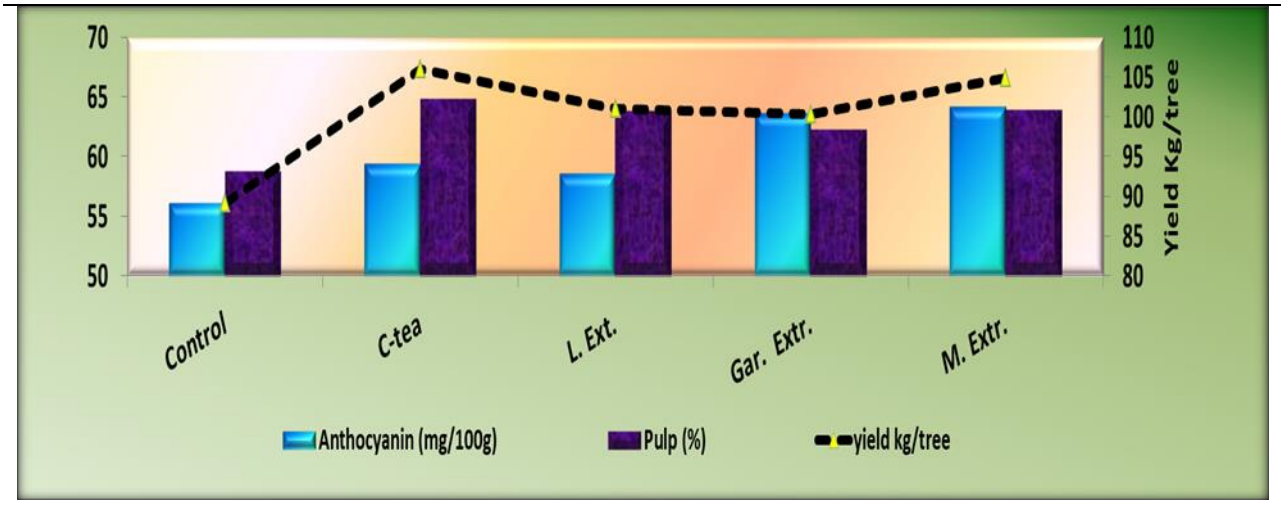

Fig 2. Anthocyanin (mg/100g), Pulp (%) and yield kg/tree of Manfalouty as affected by compost tea or some botanical extracts (average of both seasons)

Fruit cracking, acidity and tannins content:

Table 4 illustrates that compost tea, licorice extract, garlic extract and moringa extract treatments significantly reduced each of fruit cracking (%), acidity (%) and tannins content (mg/100ml) of Manfalouty pomegranate trees as compared with the control in the first and second seasons. In this respect, 10 % compost tea and 1% garlic extract treatments recorded the lowest values of fruit cracking (6.45 and 7.35 %) and (6.2 and 6.5 %) against (13.8 and 13.95%) for the control treatment in 2019 and 2020 seasons, respectively. As for acidity and tannins contents, garlic cloves and moringa leaves extracts exhibited the lowest values (0.975% and 2.27 mg/100ml, respectively) as average of both seasons (Fig. 3). Findings could be explained on the basis of the beneficial effect of compost tea due to it contains enough values of macro, micronutrients and has high useful amount of needed bacteria and fungi and, on the other hand, the enhancement of fruit quality with decreasing of acidity and tannins percentages could be due to the effective components of garlic and moringa extract (*i.e.*, some growth regulators, antioxidants, protein, amino acid nutritive, minerals and phytohormone) (Arystanova *et al.*, 2001).

Vitamin-C, juice %, total soluble solids and reducing sugars content

Table 5 showed that vitamin-C, juice %, total soluble solids and reducing sugars content were significantly affected by all treatments in both seasons. Tabulated data illustrate that Moringa followed by compost tea treatments induced a high positive effect on fruit ascorbic acid (Vitamin-C) content, with no significant differences between them, as compared with the control treatment. Moreover, average of both seasons (Fig. 4) revealed that 1.5% moringa leaves extract treatment gave the highest values of fruit ascorbic acid content (27.735 mg/ml) as compared with the control (23.753 mg/100ml) treatment. Likewise, moringa followed by compost tea treatments induced a significant positive effect on juice, total soluble solids

and reducing sugars in the first, second seasons (Table 5) as well as average of both seasons (Fig. 4), with non-significant differences between them. On the other side, control gave the lowest four contents in both seasons. The enhancement effect of moringa and compost tea may be due to their essential roles in signal transduction system, membrane stability and functions, activating transporter enzymes, metabolism and translocation of carbohydrates (Bhaskaran *et al*., 1985 and Smirnoff, 1996).

Table 4. Fruit cracking (%), Acidity (%) and Tannins content (mg/100ml) of Manfalouty as affected by compost tea and some botanical extracts during 2019 and 2020

Treatment	2019			2020		
	Fruit cracking (%)	Acidity (%)	Tannins content (mg/100ml)	Fruit cracking (%)	Acidity (%)	Tannins content (mg/100ml)
Control	13.8	1.41	2.82	13.95	1.355	2.725
C-tea	6.45	1.02	2.285	6.2	1.02	2.345
L-ext.	7.7	1.08	2.57	7.75	1.02	2.485
G-ext.	7.35	0.975	2.615	6.5	0.975	2.515
M-ext.	8.25	1.02	2.29	8.35	0.99	2.25
LSD	1.03	0.0463	0.124	1.114	0.041	0.131

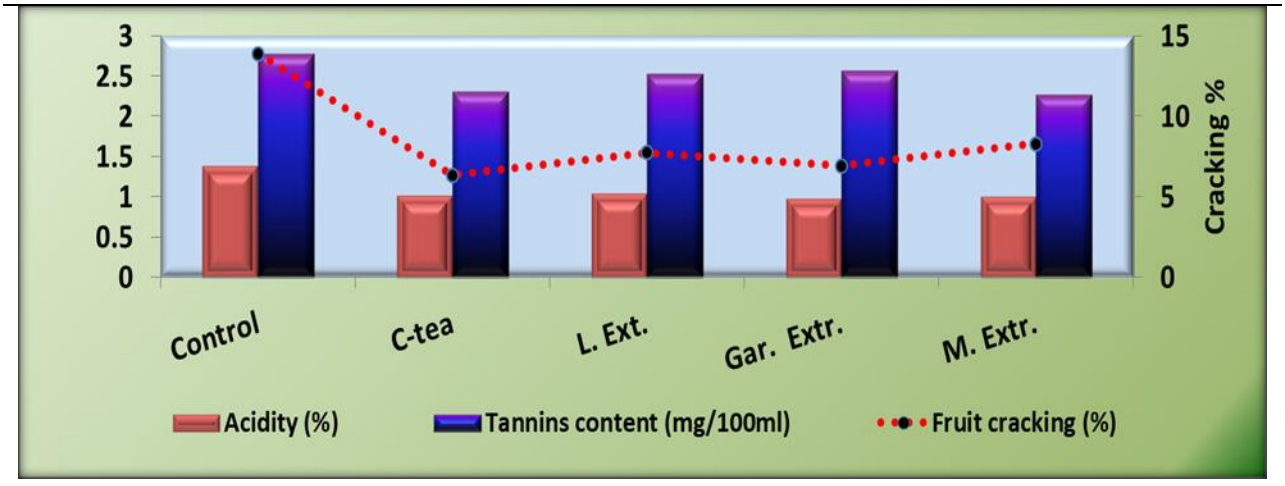

Fig. 3 Fruit cracking (%), Acidity (%) and Tannins content (mg/100ml) of Manfalouty as affected by compost tea or some botanical extracts (average of both seasons)

Table 5. Ascorbic acid, juice %, TSS% and reducing sugars content of Manfalouty fruit as affected by compost tea or some botanical extracts during 2019 and 2020

Treatments	2019				2020			
	V.C (mg/100 ml)	Juice (%)	TSS (%)	Reducing sugars (%)	V.C (mg/100 ml)	Juice (%)	TSS (%)	Reducing sugars (%)
Control	23.5	41.9	15.46	10.94	23.97	40.85	14.95	10.99
C-tea	27.1	48.92	16.35	12.49	27.17	49.58	16.24	12.39
L-ext.	27.1	46.81	15.72	11.27	27.11	47.85	15.34	11.29
G-ext.	27.0	49.3	15.8	11.33	26.85	48.92	15.73	11.24
M-ext.	27.7	49.36	16.43	12.58	27.74	49.51	16.39	12.72
LSD	0.62	1.86	0.60	1.11	0.60	1.86	0.64	1.13

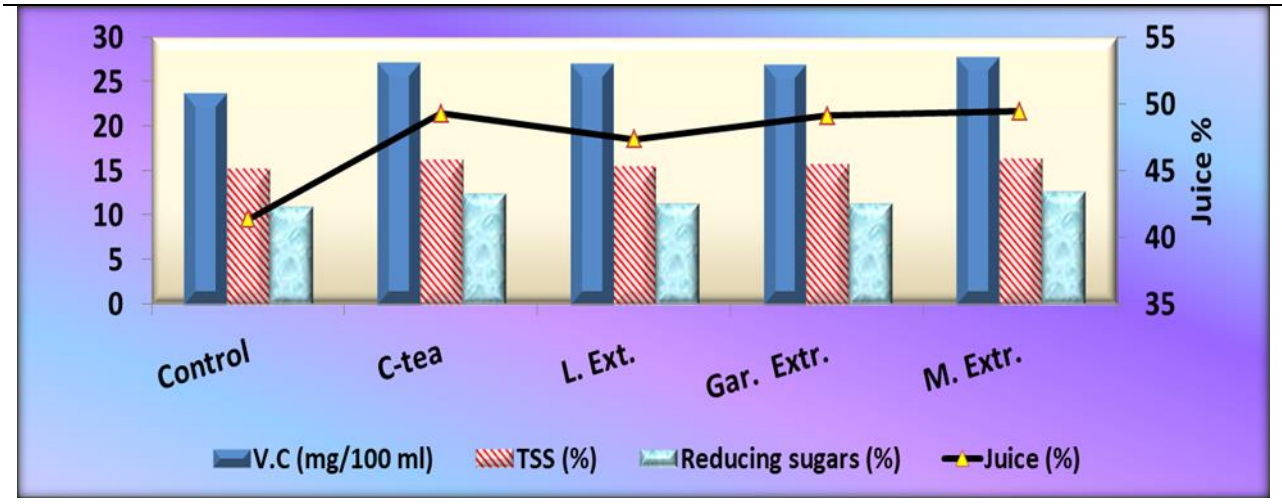

Fig. 4. Ascorbic acid (V.C), juice %, TSS% and reducing sugars content of Manfalouty fruit as affected by compost tea and or some botanical extracts average of both seasons

Leaf mineral contents:

Table 6 and Fig. 5 showed that foliar applications of all treatments significantly increased N, P, K, Mg and Ca of leaf as compared to the control treatment. However, compost tea exhibited the highest effect on N, P, Mg and Ca in both and average of both seasons as well as K content in 2nd season and average seasons. No significant differences between licorice roots and garlic cloves extracts on N, P, Mg and Ca in both seasons. Generally, the effect on average of both seasons showed that compost tea exhibited the highest positive effect on all leaf mineral contents, *i.e.*, N, P, K, Mg and Ca.

Table 6. Leaf mineral contents of Manfalouty cv. as affected by compost tea and some botanical extracts during 2019 and 2020

Treatment	2019					2020				
	N	P	K	Mg	Ca	N	P	K	Mg	Ca
Control	1.59	0.18	1.28	0.57	2.3	1.61	0.179	1.385	0.54	2.12
C-tea	2.21	0.413	1.59	0.96	2.93	2.17	0.42	1.62	0.92	2.88
L-ext.	1.99	0.334	1.6	0.85	2.74	1.981	0.371	1.59	0.85	2.69
G-ext.	1.94	0.3567	1.492	0.86	2.7	1.9	0.364	1.48	0.87	2.64
M-ext.	2.18	0.298	1.56	0.91	2.86	1.96	0.34	1.59	0.89	2.78
LSD	0.21	0.0343	0.03	0.02	0.06	0.14	0.039	0.027	0.031	0.072

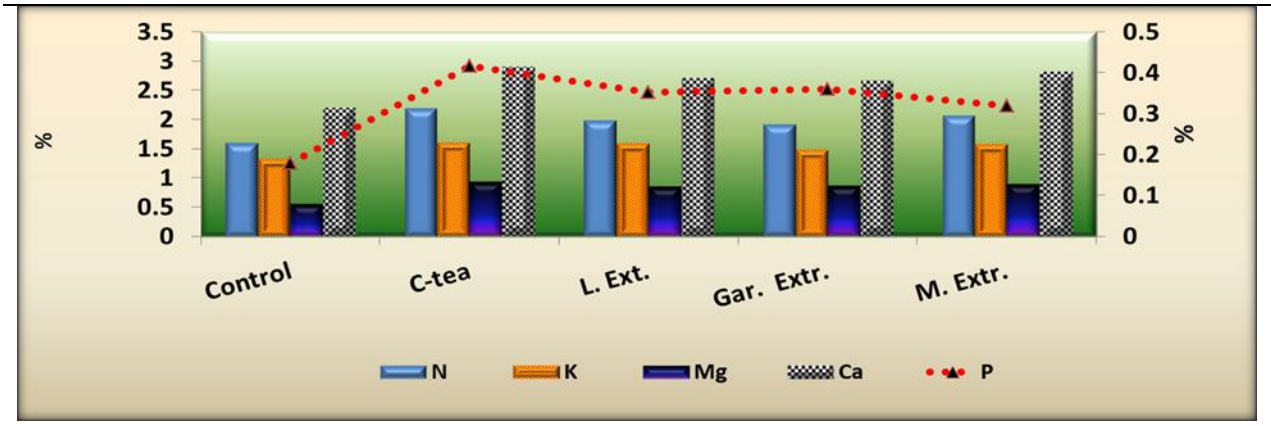

Fig. 5. Leaf Mineral Contents of Manfalouty cv. as affected by compost tea or some botanical extracts (average of both seasons)

By studying different extracts treatments, the present results are in harmony with the findings of Abdou (2010) on “Le-Conte” pear, Shaaban, *et al*. (2011) on "Anna" apple and Aly (2012) on “Costata” persimmon. Several researches stated that foliar feeding is more efficient than soil fertilization; the result is totally true in case of micronutrients under arid and semi-arid conditions (Amberger, 1991 and El-Sayed *et al*., 2000 and Fayek, *et al.,* 2014).

Concerning the compost tea, Fayed (2010) reported the enhancement of physical and chemical traits of pomegranate, following aerial applications on trees based on the increased assumption of microelements by foliar feeding. Here, our results revealed that compost tea foliar spraying increased acceptance of Manfalouty, suggesting that compost-based formulates could contribute to improve the quality by enhancing fruit attributes. It is possible to hypothesize the involvement of compost-based treatments in stimulation of secondary metabolites biosynthesis. Accordingly, Siddiqui et al. (2011) found that compost tea treatments caused an increase in the concentration of terpenoid-related compounds in the aromatic medicinal herb, Centella asiatica.

CONCLUSION

The obtained results revealed that compost tea exhibited the highest fruit weight, pulp %, yield/tree, N, P, K, Mg and Ca % as well as the reductive Fruit cracking percentage, whilst the moringa extract exhibited the highest anthocyanin, Vitamin-C, juice %, TSS and reducing sugars as well as the reductive tannins content. In meantime, licorice extract exhibited the highest fruit length and width while garlic extract exhibited the highest reductive acidity %. It could be concluded that spraying Manfalouty pomegranate trees with compost tea at 10% or 1.5% moringa leaves extract was necessary to get high yield, reduce the fruit cracking percentage, acidity and tannins as well as improve fruit quality and could be recommended due to their environmentally friendly treatment, high potentiality as well as the nutritive value.

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الملخص العربي

تأثير شاى الكمبوست وبعض المستخلصات النباتية على أشجار الرمان فى الصعيد

مصطفى صابر محمود قاسم

تم إجراء هذا العمل خلال موسمي ٢٠١٩ و ٢٠٢٠ على أشجار رمان صنف منفلوطي عمرها سبع سنوات في مزرعة خاصة بقرية النخيلة، أبو تيج، محافظة أسيوط لدراسة تأثير الرش الورقى (ثلاث مرات) باستخدام شاي الكمبوست (١٠٪) أو المستخلصات النباتية من جذور عرق السوس (٠.٥٪) اوفصوص الثوم (١٪) اوأوراق المورينجا (١.٥٪) كمحفزات نمو طبيعية على أشجار الرمان في الصنف منفلوطي. أظهرت النتائج أن جميع المعاملات تزيد بشكل كبير من جودة ومحصول الثمار ولكن يفضل تحت ظروف صعيد مصر رش ١٠٪ من شاي الكمبوست أو ١.٥٪ من مستخلصات المورينجا لتحسين وزن الثمرة والخصائص الكيميائية والإنتاجية بينما رش ٠.٥٪ من مستخلص جذور عرق السوس يفضل للحصول على أكبر حجم للثمرة ، بالإضافة إلى مستخلص فصوص الثوم (١٪) مفضل لتقليل حموضة الثمرة.