SVU-International Journal of Agricultural Sciences
Volume 4 Issue (2) pp.: 107-118, 2022
Print ISSN 2636-3801 | Online ISSN 2636-381X
Doi: 10.21608/svuijas.2022.121114.1175
RESEARCH ARTICLE

The influence of different applications of vermicompost tea on the quality of pomegranate fruits

Maha M. Abdel-Salam[1]* and Nadia M.K. Roshdy [2]

[1] *Pomology Department, Faculty of Agriculture, Assiut University, 71526 Assiut, Egypt.*
[2] *Department of Soils and Water, Faculty of Agriculture, Assiut University, 71526 Assiut, Egypt.*

Abstract

This investigation is clarifying the effect of vermicompost tea by foliar application or by adding it to the soil, either separately or in combination form, on the physical and chemical properties of pomegranate (cv. Manfalouty) fruits during two successive seasons, 2019 and 2020. Trees were treated with the vermicompost tea application by spraying fruits and leaves or adding them to the soil at a distance of 50 cm from the trunk of the tree, or a combination thereof, three times a year; the first one in the middle of July (after fruit set), the second after a month of the first application, and the last one after a month of the second. The results demonstrated that all treatments achieved the increment and improvement of all parameters compared with the control, while the treatment that included a combination of foliar application and adding to the soil gave the best effectiveness compared with the other treatments in the two successive seasons. It was also noted that the physical and chemical properties of fruits were better in the second season compared with the first, which was due to the accumulation of the effect of vermicompost in the soil. So the recommendation of this study is to use vermicompost either spray the trees or add to the soil. Both had a positive impact on fruits, while the best effect is to use a combination of both.

Keywords: Organic agriculture; Pomegranate; Vermicompost tea.

1. Introduction

The pomegranate (*Punica granatum*) is one of the most important and oldest fruit crops, having been grown since antiquity. Trees thrive in a variety of climates, including tropical and subtropical locations, as well as the Mediterranean region, particularly in Morocco, Spain, Egypt, and California's arid districts. Egypt is in the northern hemisphere's temperate zone, close to the equator, with arid or semi-arid climates suited for pomegranate production (Mirzapour and Khoshgoftar Manesh, 2013). Pomegranate belongs to the family (*Punicaceae*). It includes many cultivars such as Manfaloty, El-Hameed, Panaty, El-Sokry, Hejazi, Nab-El-Gamal, and Wonderful. Manfalouty is one of the most famous commercial cultivars cultivated in Egypt. It grows in various soil types, from light to sandy soils, if orchards are well-irrigated, except for alkaline soils, calcareous, or saline (Kitren and Louise, 2011). Recently, pomegranate has become more important to researchers who engage themselves in neurological, pharmacological, and pharmaceutical research and new drug development for their various effects and multiple bioactivities, such as antioxidants, antivirals, hypolipidemic, antibacterial, anti-diarrheal, anti-neoplastic, helminthic effects, and anti-diabetics. Pomegranate fruit is considered an abundant

***Corresponding author: Sola Emmanuel Komolafe**
Email: kemmas04@yahoo.com
Received: February 10, 2022; Accepted: April 15, 2022; Published online: April 16, 2022.

source of sugars and minerals, as well as some phenolic compounds that act as natural antioxidants and vitamin C (Zaouaya *et al.*, 2012). The pomegranate tree's fruits, bark, and leaves have long been used as traditional medicine in various cultures, dating back at least to the Egyptian Papyrus of Ebers, circa 50 B.C. (Hulya Orak, 2009). The objective of fertilizing by organic or chemical fertilizers is to enhance tree vegetative and root growth and, therefore, boost the yield as long as the fertilizer is applied as a balanced fertilizer in the proper amount at the right time and from reputable sources. (Tanari *et al.*, 2019).

Chemical fertilizers have become increasingly popular in recent years despite their harmful effects on the environment, human and plant health, and high costs, because they have a good effect on world food production because they work as fast nutrition for plants, causing them to grow more quickly and efficiently. Because of the passive effect of chemical fertilizers, nowadays a major target is focused on minimizing the intensive amounts of mineral fertilizers (Abd Al-Hadi and Abd AL-Adeem, 2005).

Organic agriculture is a method that avoids or minimizes the use of synthetic fertilizers, growth regulators, livestock feed additives, and pesticides. Bio-fertilization, animal manures, crop residues, crop rotations, green manures, legumes, mineral-bearing rocks, off-farm organic wastes, mechanical cultivation, and components of biological pest management are used as much as possible in organic agricultural systems to retain soil production. The fundamental issue in the organic production system, however, is yield decline (Lind *et al.*, 2003). The influence of organic manure application is noticeable to a great extent on both the nutrient sources for plants and the physical and chemical properties of the soil in the long term (EL-Kouny *et al.*, 2004; Abbas *et al.*, 2006; Tirol-Padre *et al.*, 2007). Some researchers demonstrated that combining sources both organic and chemical, often known as integrated nutrient management, is a method of raising agricultural yields and productivity in a sustainable manner (Mahajan *et al.*, 2008). Although organic manure combined with mineral fertilizers boosted crop development and yield in the short term, organic manure alone improved the fruit quality, nutritional content, and yield of date and grape. (Marzouk and Kassem, 2011).

Recently, researchers worldwide have been focusing on studying vermicompost applications and their influences on plants and soil (Adhikary, 2012). Edwards and Burrows (1988) described vermicompost as a peat-like substance resulting from a non-thermophilic process that includes bio-degradation and stability of organic materials through interactions between microorganisms and earthworms. It's rich in macro and micronutrients, growth hormones, enzymes including proteases, amylases, lipase, cellulose, and chitinase, immobilized microflora, and vitamins, and it's made by earthworms. Even after the enzymes have been removed from the worms, they continue to degrade organic material (Barik *et al.*, 2011).

It is characterized by its water-holding capacity, drainage, high porosity, aeration, and microbial activity. It's also possible to enhance soil organic carbon, exchangeable calcium, phosphates, nitrates, and a variety of other nutrients for plants (Orozco *et al.*, 1996; Garcia-Gil *et al.*, 2000; Bulluck *et al.*, 2002; Jindo *et al.*, 2016). Vermicompost has been shown to have a positive impact on multi kinds of crops, such as flowering plants, ornamentals, legumes and cereals, field crops, and vegetables (Chan and Griffiths, 1988; Edwards and Burrows, 1988; Mba, 1996; Subler *et al.*, 1998; Atiyeh *et al.*, 2000). Vermicompost contains many nutrient substances containing N, P, K, Fe, Mg, Ca, Mn, Zn, S, B, and Cu. It improves plant nutrition as well as the amount of chlorophyll in the leaves, photosynthesis, and the nutrient content of various plant components (roots,

shoots, and fruits). Vermicompost contains a sufficient amount of humic acid for plant health since it promotes the synthesis of phenolic compounds like flavonoids and anthocyanins, which may improve plant quality and function as a disease and insect preventative. (Theunissen *et al.*, 2010). This research aims to study the effect of vermicompost tea by both foliar applications and adding it to the soil alone form, or in combination form, to improve the physical and chemical properties of pomegranate (*Punica granatum* Manfalouty) and for reducing the use of chemical fertilizers and replacing them with organic fertilizers resulting from plant and animal waste to avoid all of the following: Long-term damage caused by chemical fertilizers to the plant and soil - Reducing the cost of fertilizing agricultural fields as chemical fertilizers are expensive - Providing consumer food safety.

2. Materials and Methods

The experiment was carried out over two continuous growing seasons (2019 and 2020) to study the effect of vermicompost application on pomegranate trees of the Manfalouty cultivar, which was cultivated at the Pomology Department, Faculty of Agriculture, Assiut University. 25 pomegranate trees 15 years old were selected to be as uniform as possible, spaced at 5x5 m apart, and grown in clay soil. The tested trees were healthy, as uniform in vigor as possible, and divided for this study. Irrigation, pest management, and other conventional agricultural methods were applied to all of the trees, and fertilizer (FYM @ 20 kg/tree) was supplied to all the trees (including control) in December.

Before beginning the study, both the tested soil and the vermicompost tea used in the experiment were analyzed. Tables 1 and 2 areThe trees selected were treated with the following applications three times a year on the same tree. The first one is in the middle of July (after the fruit set), the second after the month of the first application, and the last one after the month of the second.

Control (without any mineral fertilization).

Spraying with vermicompost (one liter of vermicompost/20 liters of water/tree).

Soil supplement of vermicompost (one liter of vermicompost for every 5 liters of water/tree).

Combination between spray and soil supplement treatment/tree.

Each treatment sprayed five trees and was taken three replicates only for each treatment, and two fruits from each tree were harvested.

2.1. Prepare vermicompost tea

10 liters of water were added for each kilogram and a half of vermicompost and placed in a water-permeable cloth bag. 25 grams of molasses - 5 grams of magnesium sulfate - 1 gram of monopotassium phosphate - citric acids for reaching pH 6-10 grams of humic acid - ventilate for 48 hours, then take it from the solution and use it directly.

2.2. Yield weight

When fruits reached the ripening stage in each season (approximately in the middle of October), they were harvested separately from each tree, and their weight was calculated by kilogram per tree.

2.3. The percentages of fruit cracking, fruit sunburn, and marketable fruit

The number of fruits cracked (FCP), sunburned (FBP), and marketable fruit (MFP) was determined for each treatment at the time of harvest as follows: -

$$FCP = \frac{NCF}{TNF} \times 100$$

$$FBP = \frac{NBF}{TNF} \times 100$$

$$MFP = \frac{[TNF - NCF - NBF]}{TNF} \times 100$$

*NBF is the number of sunburned fruits.

*TNF is the total number of fruits.

*NCF is the number of cracked fruits.

2.4. Leaf constituents

At harvest date, leaves were randomly collected from the middle part of non-fruiting shoots of

each replicate tree in both seasons to determine total chlorophyll and N.P.K content.

Total chlorophyll content was determined with a SPAD-502-meter (Minolta Camera Co., Osaka, Japan).

N.P.K Contents: Leaf samples were first cleaned with tap water, then distilled water and non-ionic detergent, before being dried in an air oven at 70°C and manually ground with a mortar and pestle. One gram of powder was burned at 550°C for 25 minutes in a muffle oven. The resulting white ash was then dissolved in 10 ml of 2 N HCl and distilled water adjusted to a volume of 100 ml for macro-and micronutrient analysis (Chapman and Pratt, 1961). A flame photometer was used to determine potassium content, and a spectrophotometer was used to determine phosphorous content. The Kjeldahl technique was used to determine total nitrogen content (Olsen et al.,1954 and Jackson, 1973).

2.5. Fruits properties

Two fruits were taken randomly from the yield of each tree (3 replicates) and made as a composite sample for physical and chemical determinations.

2.6. Physical properties:

The weight of each fruit, arils and peel of fruit were determined in grams by using an analytical balance.

Juice volume of arils was determined in ml by the Graduated cylinder.

Table 1. Analysis of the tested soil before starting the study.

Characters		Character	
Sand (%)	15.43	Total N (%)	0.16
Silt (%)	33.22	Available P (mg/kg)	21.61
Clay (%)	51.35	Available K (mg/kg)	401.33
Texture	Clay	DTPA-extractable (mg/kg)	
pH (1:1 suspension)	8.10	Fe	13.19
E.C (dS/m^{-1})	2.69	Mn	15.16
Organic matter (%)	1.32	Zn	2.35
$CaCo_3$ (%)	3.66	Cu	2.11

Table 2. Analysis of the vermicompost tea which used in experimental

Characters (These contents per liter)	
natural material & element	35%
Natural plant extracts	30%
N	3%
P	1.5%
K	20%
Mg	0.12%
Si	5%
Fe	350 ppm
Zn	335 ppm
Mn	160 ppm

2.7. Chemical properties:

Total soluble solid (T.S.S): According to A.O.A.C. 1990, the soluble solids content in fruit juice was determined using a hand refractometer.

Titratable acidity: was estimated as ml of citric acid per 100 ml of juice through titration with NaOH at 0.1N using phenolphthalein as an indicator as outlined in the A.O.A.C. 1990.

Titratable acidity (%) = Standard solution (N) X base solution (ml) x 0.06404 ----------X 100
Total juice volume (ml)

*The equivalent weight of citric acid =0.06404

*juice volume =5ml

*The NaOH was adjusted by using a known volume of oxalic acid 0.1M

$$\text{TSS/Acid ratio} = \frac{\text{T S S}}{\text{Total Acid contents}}$$

2.8. Total anthocyanins

The determination of the total anthocyanin was realized by the method proposed by Di Stefano et al.,1989. The absorbance was measured at 540 nm after the samples were diluted with a solution of 70/30/1 (v/v/v) ethanol/water/HCl

(concentrated). The overall anthocyanin contents were represented as malvidin-3-glucoside equivalents due to the lack of a malvidin-3-glucoside standard.

TA540 nm (mg/L) = A540 nm16.7d

*Where A540 nm is the absorbance at 540 nm and d is the dilution.

2.9. Statistical analysis

The experiment was set up as a three-replication randomized full blocks design. SPSS software was used to do an analysis of variance (ANOVA). The LSD test was used to determine to mean differences. (least significant difference) at P < 5% based on Gomez and Gomez (1984) in Statistics 8.1 (Analytical Software, 2008).

3. Result

3.1. Leaf constituents, including total chlorophyll, N, P, and K content

The results in Table 3 demonstrated that all treatments had a positive effect on the total chlorophyll, N, P, and K percentages in leaves and gave significant differences compared with the control in both seasons.

The values of total chlorophyll had insignificant differences between treatments in both seasons. The highest value of chlorophyll was recorded in leaves that were sprayed with vermicompost (65.97, 66.97) and the lowest value was recorded in control (56.03, 56.03) in both seasons, respectively.

There were no significant differences between T_2 and T_4 values on N% of leaves compared with T_3 values in both investigative seasons, respectively. The best values of N % were found in T_2(1.95 & 2.02%) and T_4 (1.98, 2.03%), while the least value was found in T_1(1.55, 1.58%).

There were minor differences between T_2 with both T_3 and T_4 in the percentage of P of leaves. While there were significant differences between T_3 and T_4. The maximum effect was recorded on T_4 (0.65, 0.69 %) and the minimum value was recorded on T_3 (0.57;0.58 %). The control one gave the lowest value (0.31, 0.34%) in both seasons, respectively.

In the first season, there was no difference among treatments on the percentage of K of leaves whereas in the second season there were significant differences between T_4 and T_2 compared with T_3. T_4 gave the highest value (1.75, 1.78%) and the control treatment gave the lowest value (1.29, 1.33%) in the two successive seasons.

Table 3. The influence of different applications of vermicompost tea on leaves of pomegranate (*Punica granatum* Manfalouty) fruits during 2019 and 2020 seasons.

Treatments	Total Chlorophyll SPAD		N %		P %		K %	
	2019	2020	2019	2020	2019	2020	2019	2020
Control (T_1)	56.03 B	56.03 B	1.55 C	1.58 C	0.31 C	0.34 C	1.29 B	1.33 C
Vermicompost spray (T_2)	65.97 A	66.97 A	1.95 A	2.02 A	0.62 AB	0.65 AB	1.71 A	1.74 A
Vermicompost application (T_3)	64.63 A	64.97 A	1.85 B	1.88 B	0.57 B	0.58 B	1.66 A	1.65 B
Vermicompost Spray + application (T_4)	65.53 A	66.20 A	1.98 A	2.03 A	0.65 A	0.69 A	1.75 A	1.78 A
SE+	1.45	1.33	0.04	0.03	0.03	0.026	0.039	0.035

*Means separation by LSD tests at $P \leq 0.05$. The same letters within columns are not significantly different.
Ascending order starts from (A) means the highest value until reaches the letter which has the lowest value.

3.2. Physical properties: fruit weight, peel weight, arils' weight, juice volume, juice weight.

The results in Table 4 described, that all treatments increased the fruit weight compared with the control one by significant differences. In the first season, there was an insignificant difference between T_2 and T_4 (535, 541.7 gm), respectively, compared with T_3, which had a lower value (503 gm). whereas, in the second season, T_4 (574.2 gm) had the highest value

compared with T_2 and T_3 (543.3, 551.7 gm), respectively, with a significant difference.

Data in the same table demonstrated the effect of treatments on fruit peel. In the first season, there was an insignificant difference between the control and T_4, which gave the lowest values (103.3, 108.3 gm), respectively, while the biggest value was recorded in T_2 (128.3 gm).

In the second season, there were insignificant values among treatments and significant values between treatments and the control. The highest value was in T_3 (183.8 gm) and the lowest value was in control (113.3 gm).

Data in Table 4 illustrated that all treatments had a significant effect on arils' weight compared with the control. In the first season, the highest value was found in T_2 (236.7 gm), while in the second season, T_4 had the highest one (265.8 gm). In both seasons, the lowest value was in the control (135 and 150 gm, respectively).

In the same table, results proved that all treatments had a positive effect on the juice volume and juice weight and there was an insignificant difference between them and there were significant differences between all treatments with the control in two investigated seasons, respectively.

T_4 recorded the highest amount of juice (64, 76.2 ml) and the control recorded the lowest amount (40,45.1 ml) in both seasons, respectively. In the same way, T_4 had the highest value in juice weight (66.82,77.8 g) compared with the control had the lowest value (41.7, 47 g).

Table 4. The influence of different applications of vermicompost tea on physical properties of fruit of Pomegranate (*Punica granatum* Manfalouty) fruits during 2019 and 2020 seasons.

Treatment	Fruit weight (gm)		Peel weight (gm)		Aril's weight (gm)		Juice volume (ml)		Juice weight (gm)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control (T1)	340 C	335 C	103.3 B	113.3 B	135 C	150 C	40 B	45.1 B	41.7 B	47 B
Vermicompost spray (T2)	535 A	543.3B	128.3 A	173.3 A	236.7 A	243.3 B	60 A	71.7 A	62.3 A	75.3 A
Vermicompost application (T3)	503 B	551.7 B	113.3 AB	183.8 A	218.3 B	240 B	56 A	69.4 A	59.3 A	72.8 A
Vermicompost spray+application (T4)	541.7 A	574.2 A	108.3 B	176.7A	211.7 B	265.8 A	64 A	76.2 A	66.82A	77.8 A
SE+	9.50	7.4	7.8	7.3	5.0	6.3	3.39	4.9	3.72	5.51

**Means separation by LSD tests at $P \leq 0.05$. The same letters within columns are not significantly different.
Ascending order starts from (A) means the highest value until reaches the letter which has the lowest value.

3.3. Yield properties: Fruit cracking %, Fruit sunburn %, Marketable fruit %, Yield (kg/tree)

Table 5 had results illustrating the effect of treatments on yield properties, and they gave a positive effect compared with the control in two investigative seasons. The results in this table showed the effect of treatment on fruit cracking %. In the first season, data proved, there were significant differences between T_4 with both T_3 and the control, and there was a trivial difference between T_2 and T_4. the lowest rate was found in T_4 (2.90%), while, the highest rate was found in the control (7.73 %). In the second season, there were significant differences between treatments and control and there were significant differences between T_4 and both T_2 and T_3. The lowest rate was found in T_4 (3.23%) and the highest rate was found in the control (7.70 %).

Regarding fruit sunburn % the data proved that there were significant differences between all treatments and the control. The minimum rate was found in both T_2 (7.60,7.00 %) and T_4 (5.77, 5.50 %) with insignificant differences between them and control, which gave the maximum rate (15.93, 16.93%) in two successive seasons, respectively.

About the marketable fruit % in the same table data demonstrated that, in the first season, there was no difference between T_2 (88.73%), and T_4 (91%); they gave the highest rate of marketable fruit compared with the control (76.27 %) and T_3 (80.13 %), which gave the lowest rate. Moreover, in the second season, there were significant differences between treatments and the control. T4 recorded the maximum (92.67 %) value compared with the other treatments and the control, which gave the lowest value (73.27%).

Results in this table proved that all treatments gave significant differences in yield compared with the control in each season, respectively. The high rate was recorded in T_4 (114.67, 113.50 kg) and the low rate was obtained in T_1(53.33, 53.33kg) in both successive seasons.

Table 5. The influence of different applications of vermicompost tea on yield properties of Pomegranate (*Punica granatum* Manfalouty) fruits during 2019 and 2020 seasons.

Treatment	Fruit cracking %		Fruit sunburn %		Marketable fruit %		Yield (kg/tree)	
	2019	2020	2019	2020	2019	2020	2019	2020
Control (T1)	7.73 A	7.70 A	15.93 A	16.93 A	76.27 B	73.27 C	53.33 C	53.33 C
Vermicompost spray (T2)	5.23 AB	5.10 B	7.60 C	7.00 C	88.73 A	83.08 B	102.33 B	100.33B
Vermicompost application (T3)	6.87 A	5.13 B	13.17 B	13.3 B	80.13 B	80.77 B	92.67 B	93.33 B
Vermicompost spray+application (T4)	2.90 B	3.23 C	5.77 C	5.50 C	91.0 A	92.67 A	114.67A	113.50A
SE+	1.35	0.675	0.998	0.866	1.832	1.699	4.384	3.926

*Means separation by LSD tests at $P \leq 0.05$. The same letters within columns are not significantly different.
Ascending order starts from (A) means the highest value until reaches the letter which has the lowest value.

3.4. Chemical properties: TSS %, Acidity%, TSS/acidity, Total anthocyanin.

The results in Table 6 explained the effect of treatments on the chemical properties of aril's juice and compared them with the control during two successive seasons.

Data reported that there weren't any differences between treatments and the control in the first season, and they had the same effect on TSS. In the second season, there were trivial differences in value between treatments, including the control, but there was a significant difference between T_1 and T_3. The best value of TSS was found in T_1 (14%) while the lowest value was found in T_3 (13.2%).

Data illustrated the treatments gave significant values of acidity percentage compared with the control in the first season.

The highest percentage was obtained with the control (1.07 %), and the lowest percentage was found in all treatments (0.99 %). On the other hand, there was no difference between treatments and the control in the second season, and all treatments had the same effect on acidity% as the control.

Furthermore, the value found in T_1(12.8%) in the first season had the lowest effect on TSS/acid ratio compared with the other treatments, while in the second season there was no difference in effect between the control and treatments on TSS/acid ratio.

In the same table, the results demonstrated that T_2 & T_3 had the maximum effect on anthocyanin in two seasons. In the first season, T_4 (0.056 mg/100gm) gave the minimum value of anthocyanin compared with the other treatments, and the control. Whereas in the second season T_1 &T_4 (0.06,0.061mg/100gm) gave the minimum values of anthocyanin compared with other treatments T_2 and T_3(0.09, 0.098mg/100gm).

Table 6. The influence of different applications of vermicompost tea on chemical properties of fruit of Pomegranate (*Punica granatum* Manfalouty) fruits during 2019 and 2020 seasons.

Treatment	TSS %		Acidity%		TSS/acidity		Total anthocyanin (mg/100gm)	
	2019	2020	2019	2020	2019	2020	2019	2020
Control (T1)	13.7 A	14 A	1.07 A	1.02 A	12.8 B	14.07 A	0.0653 B	0.06 B
Vermicompost spray (T2)	14.2 A	13.9 AB	0.99 B	1.07 A	14.4 A	13 A	0.0967 A	0.09 A
Vermicompost application (T3)	14.2 A	13.2 B	0.99 B	1.08 A	14.4 A	12.3 A	0.0963 A	0.098 A
Vermicompost spray+application (T4)	14.3 A	13.67 AB	0.99 B	1.067 A	14.6 A	12.88 A	0.056 C	0.061 B
SE+	0.31	0.4673	0.029	0.0613	0.6	1.146	0.003	0.003

*Means separation by LSD tests at $P \leq 0.05$. The same letters within columns are not significantly different.

Ascending order starts from (A) means the highest value until reaches the letter which has the lowest value. b

4. Discussion

When compared to the control, all treatments had a considerable impact on the physical and chemical attributes of the fruit. It's most likely because of the hormones or humate concentration in the vermicompost, as well as a variety of plant nutrients. It was also noted that the physical and chemical properties were better in the second season compared with the first, which was due to the accumulation of the effect of vermicompost in the soil (Baligar *et al.,* 2001; Arancon *et al.,* 2003; Roy *et al.,* 2006).

Earthworm excrement is rich in micronutrients, macronutrients, and humus, and is known as vermicompost. It can improve the soil's physical qualities, as well as the health of the soil and crop productivity (Azarmi *et al.,* 2008; Adhikary, 2012).

The major components that characterize the agronomical potential of soil are its physical features, such as tilth, texture, and soil structure. Water availability, nutrient uptake and movement, root penetrability, potential rooting volume, and soil aeration will all be influenced by these characteristics (Roy *et al.,* 2006). Soil structure has an impact on soil moisture content as well as chemical qualities like cation exchange capacity (CEC), or the soil's ability to store positively charged ions (Delgado and Gómez, 2016). Therefore, vermicompost is very beneficial for soil, as increase the soil organic substance (SOM) composition, which in turn helps in maintaining good soil aggregation, improving soil aeration, increasing nutrient availability, and protecting against soil erosion (Baligar *et al.,* 2001; Roy *et al.,* 2006).

In addition, vermicompost contains plant nutrients like N, P, K, Fe, Ca, Mg, S, B, Cu, Zn, and Mn, which contribute to the nutritious content of various plant components like roots, shoots, and fruits (Theunissen *et al.,* 2010). The living microorganisms found in vermicompost tea encourage both nutrient uptake, plant growth, and disease resistance (Scheuerell and Mahaffee, 2002; Ingham, 2005; Hargreaves *et al.,* 2009). So, the application of a watery extract of vermicompost (vermicompost tea) has been proven to improve crop yield, plant health, and nutritive components in the plant (Gamaley *et al.,* 2001; Pant *et al.,* 2009).

Vermicompost can also promote the establishment of nitrogen-fixing bacteria in the rhizosphere, which increases N availability by releasing biologically fixed nitrogen through close contact between ingested particles and soil. They discovered that after applying the vermicompost, the soil NH4 and NO3 levels improved instantly (Mackay *et al.,* 1982; Singh and Varshney, 2013).

The application of vermicompost had the same effect as the application of inorganic fertilizers, indicating that vermicompost is a viable alternative to chemical fertilizer application (Singh *et al.,* 2008).

Arancon *et al.* (2003) proved that the enhancements in crop growth and fruit yields could be attributable to a partially considerable increase in soil microbial biomass following vermicompost application, resulting in greater hormones or humate content in the vermicompost treatment.

All of the above was taken into consideration to illustrate and demonstrate the results. About the result of leaf constituents including total chlorophyll, N, P, and K content all treatments gave a positive effect compared with the control this reason is due to the content of vermicompost which had several plant nutrients which progress the nutritional value of various plant parts such as roots, shoots, and fruits (Theunissen *et al.*, 2010).

5. Conclusion

This research studied the effect of foliar application of vermicompost tea, applying vermicompost tea to the soil and using it either as an individual or in combination form. It was proven that it could increase and improve the physical and chemical properties of pomegranates (*Punica granatum* Manfalouty). Moreover, the effect of vermicompost tea is the same as that of inorganic fertilizers, so using it is a promising natural resource that can be used as an alternative to synthetic fertilizers for crop development, reducing chemical fertilizer application and hence reducing both the environmental pollution and the cost of the fertilizer. The research recommended that all treatments, especially those that include the combination of foliar and application of vermicompost tea, be used to the best effect for the quality and improvement of pomegranates. In this experiment, it was observed that spraying trees with vermicompost alone had a quick and effective effect on the quality of pomegranates. The addition of vermicompost to the soil alone had a slight effect on pomegranates in the first season, while it had a clear effect in the second season due to the cumulative effect of vermicompost tea. However, the combination of spraying and application had the best effect on the quality of pomegranates.

Acknowledgment for: - Vermi land Agriculture **https://www.facebook.com/Vermi-land-104891104294269/**

Authors' Contributions
All authors are contributed in this research.
Funding
There is no fund in this research.
Institutional Review Board Statement
All Institutional Review Board Statement are confirmed and approved.
Data Availability Statement
Data presented in this study are available on fair request from the respective author.
Ethics Approval and Consent to Participate
This work carried out at Pomology department and department of Soils and Water and followed all the departments instructions.
Consent for Publication
Not applicable.
Conflicts of Interest
Declare no conflict of interest.

6. References

A.O.A.C. (1990). *'Association of Official Agriculture Chemists',* Official Methods of Analysis 9th, 832.

Abbas, H.H., Noufal, E.H.A., Farid, I.M., Ali, I.M.E. (2006). 'Organic manuring and bio-fertilization approach as potential economic and safe substitutes for mineral nitrogenous fertilization', *Egyptian Journal of Soil Science*, 46(2), pp. 219-235.

Abd AL-Hadi, S., Abd AL-Adeem. (2005). Production of Pomegranate under organic and bio fertilized systems.

Adhikary, S. (2012). Vermicompost, the story of organic gold', A review. *Agric. Sci.,* 3, pp. 905-917.

Analytical Software, (2008). *'Statistics Version 8.1 (8.1)',* Analytical Software, Tallahassee, Florida, USA.

Arancon, N.Q., Edwards, C.A., Bierman, P., Metzger, J.D., Lee S., Welch, C. (2003). *'Effects of vermicompost on growth and*

marketable fruits of field-grown tomatoes, peppers, and strawberries', the 7th international symposium on earthworm ecology·CardiffWales·2002. Pedobiologia, 4 7, pp.731-735.

Atiyeh, R., Subler, S., Edwards, C., Bachman, G., Metzger, J., Shuster, W. (2000). 'Effects of vermicomposts and composts on plant growth in horticultural container media and soil', *Pedobiologia,* 44, pp. 579-590.

Azarmi, R., Giglou, M.T., Taleshmikail, R.D. (2008). 'Influence of Vermicompost on Soil Chemical and Physical Properties in Tomato (*Lycopersicum esculentum*) Field', *African Journal of Biotechnology,* 7, pp. 2397-2401.

Baligar, V., Fageria, N., He, Z. (2001). Nutrient use efficiency in plants. Communications in Soil Science and Plant Analysis, 32, pp. 921-950.

Barik, T., Gulati, J.M.L., Garnayak, L.M., Bastia, D.K. (2011). 'Production of vermicompost from agricultural wastes.', *Agric. Reviews,* 31(3), pp. 172-183.

Bulluck, L., Brosius, M., Evanylo, G., Ristaino, J. (2002). 'Organic and synthetic fertility amendments influence soil microbial, physical, and chemical properties on organic and conventional farms', *Appl. Soil Ecol.,* 19, pp. 147-160.

Chan, P.L.S., Griffiths, D.A. (1988). 'The vermicomposting of pre-treated pig manure', *Biological Wastes,* 24, pp. 57-69.

Delgado, A., Gómez, J.A. (2016). **'**The soil. Physical, chemical, and biological properties', *In Principles of Agronomy for Sustainable Agriculture; Springer: Cham, Switzerland,* pp. 15-26.

Di Stefano, R., Cravero, M.C., Gentilini, N. (1989). 'Meto-di per lo studio dei polifenoli dei vini', *L'enotecnico,* 5, pp. 83-90.

Edwards, C., Burrows, I. (1988). *'The potential of earthworm composts as plant growth media, in Earthworms in Waste and Environmental Management',* eds C. A. Edward and E. F. Neuhauser (Hague: SPB Academic Press), 2132.

EL-Kouny, H.M., EL-Assar, A.M., Mohamed, S.G. (2004). 'Effectiveness of natural organic amendments biologically activated composted and mineral fertilization sources of potassium in improving soil properties and productivity of Zaghloul cv. date palm in calcareous soil', *Assiut Journal of Agricultural Sciences,* 35(2), pp.195-214.

Gamaley, A.V., Nadporozhskaya, M.A., Popov, A.I., Chertov, O.G., Kovsh, N.V., Gromova, O.A. (2001). 'Non-root nutrition with vermicompost extracts as the way of ecological optimization. Plant nutrition: Food security and sustainability of agroecosystems through basic and applied research. Fourteenth International Plant Nutrition Colloquium', *Springer Netherlands, Hannover, Germany.,* pp. 862-863.

Garcia-Gil, J., Plaza, C., Soler-Rovira, P., Polo, A. (2000). 'Long-term effects of municipal solid waste compost application on soil enzyme activities and microbial biomass', *Soil Biol. Biochem.,* 32, pp. 1907-1913.

Gomez, K.A., Gomez, A.A. (1984). *'Statistical Procedures for Agricultural Research',* John Wiley and Sons, 2nd Ed., New York, pp. 20-29 and 329-387.

Hargreaves, J.C., Adla, M.S., Warman, P.R. (2009). 'Are compost teas an effective nutrient amendment in the cultivation of strawberries? Soil and plant tissue effects', *J. Sci. Food Agric.,* 89, pp. 390-397.

Hulya, O.H. (2009). 'Evaluation of antioxidant activity, colour, and some nutritional characteristics of pomegranate (*Punica granatum* L.) juice and its sour concentrate processed by conventional evaporation', *Int. J. Food Sci. Nutr.,* 60(1), pp.1–11.

Ingham, E.R. (2005). 'The Compost Tea Brewing Manua', *Latest Methods and Research Soil Food Web, Corvallis,* OR pp. 13-86.

Jackson, M.L. (1973). *'Soil chemical analysis',* Prentic-Hall, Inc. Englewood Cliffs, N.J. New Delhi**.**

Jindo, K., Chocano, C., De Aguilar, J.M., Gonzalez, D., Hernandez, T., Garcia, C. (2016). 'Impact of compost application during 5 years on crop production, soil microbial activity, carbon fraction, and humification process', *Commun. Soil Sci. Plant Anal.,* 47, pp.1907-1919.

Kitren, G., Louise, F. (2011). *'Pomegranate Production in Afghanistan',* UCDAVIS, College agricultural and Environmental Sci. http//ip.ucdavis.edu.

, H. Lind, K., Lafer, G., Schloffer, K., Innerhoffer, G., Meister (2003). *'Organic Fruit Growing',* CABI Publishing, Wallingford, UK., ISBN-13: 9781845933401, pp. 281.

Mackay, A., Syers, J., Springett, J., Gregg, P. (1982). 'Plant availability of phosphorus in superphosphate and a phosphate rock as influenced by earthworms', *Soil Biol. Biochem.,* 14, pp. 281-287.

Mahajan, A., Bhagat, R.M., Gupta, R.D. (2008). Integrated nutrient management in sustainable rice-wheat cropping system for food security in India', *SAARC Journal of Agriculture*, 6(2), pp.149-163.

Marzouk, H.A., Kassem, H.A. (2011). 'Improving fruit quality, nutritional value and yield of Zaghloul dates by the application of organic and/or mineral fertilizers', *Scientia Horticulturae,* 127(3), pp. 249- 254.

Mba, C.C. (1996). 'Treated-cassava peel vermicomposts enhanced earthworm activities and cowpea growth in field plots', *Resour. Conserv. Recyc.*, 17, pp. 219-226.

Mirzapour, M.H., Khoshgoftarmanesh, A.H. (2013). 'Effect of soil and foliar application of iron and zinc on quantitative and qualitative yield of pomegranate', *J. Plant Nutr.,* 36(1), pp. 55-66.

Olsen, S.R., Cole, C.V., Watanabe, F.S., Dean, I.A. (1954). *'Estimation of available phosphorus by extraction with sodium bicarbonate',* USDA Circ.939. U. S. Gov. print. office, Washington, Dc.

Orozco, F., Cegarra, J., Trujillo, L., Roig, A. (1996). 'Vermicomposting of coffee pulp using the earthworm Eisenia fetida: effects on C and N contents and the availability of nutrients', *Biol. Fertil. Soils,* 22, pp. 162–166.

Pant, A., Radovich, T.J.K., Hue, N.V., Talcott, S.T., Krenek, K.A. (2009). 'Vermicompost extracts influence growth, mineral nutrients, phytonutrients, and antioxidant activity in Pak choi (*Brassica rapa* cv. Bonsai, Chinensis group) grown under vermicompost and chemical fertilizer', *J. Sci. Food Agric.,* 89, pp. 2383-2392.

Roy, R., Finck, A., Blair, G., Tandon, H. (2006). *'Plant Nutrition for Food Security: A Guide for Integrated Nutrient Management (FAO Fertilizer and Plant Nutrition Bulletins)',* Food and Agriculture Organization of the United Nations, Rome.

Scheuerell, S., Mahaffee, W. (2002). 'Compost tea: Principles and prospects for plant disease control', *Comp. Sci. Util.,* 10, pp. 313-338.

Singh, R.P., Varshney, G. (2013). 'Effects of carbofuran on availability of macronutrients and growth of tomato plants in natural soils and soils amended with inorganic fertilizers and vermicompost', *Commun. Soil Sci. Plant Anal.,* 44, pp. 2571-2586.

Singh, R., Sharma, R.R., Kumar, S., Gupta, R.K., Patil, R.T. (2008). 'Vermicompost substitution influences growth, physiological disorders, fruit yield, and quality of strawberry (Fragaria x ananassa Duch.)', *Bioresour. Technol.,* 99, pp. 8507-8511.

Subler, S., Edwards, C., Metzger, J. (1998). *'Comparing vermicompost and composts',* Biocycle, 39, pp. 63-66.

Tanari, N., Ramegowda, S., Thottan A., Girigowda, M. (2019). 'Effect of fertigation of primary nutrients on pomegranate (*Punica granatum* L.) fruit productivity and quality', *Tropical Plant Research*, 6(3), pp. 424-432.

Theunissen, J., Ndakidemi, P.A., Laubscher, C.P. (2010). 'Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production', *International Journal of the Physical Sciences*, 5(13), pp. 1964-1973.

Tirol-Padre, A., Ladh, J.K., Regmi, A.P., Bhandari, A.L., Inubushi, K. (2007). 'Organic amendments affect soil parameters in two long-term rice-wheat experiments', *Soil Science Society of America journal*, 71, pp. 442-452

Zaouay, F., Mena, M., Garcia-Viguera, C., Mars, M. (2012). 'Antioxidant activity and Physico-chemical properties of Tunisian grown pomegranate (*Punica granatum* L.) cultivars', *Industrial Crops and Products*, 40, pp. 81– 89.