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Evaluation Efficacy of Some Combinations of Organic Fertilizers on Productivity, Fruit Quality and Nutritional Status of Wonderful Pomegranate

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TO EVALUATE efficacy of fertilizing with different combinations of organic fertilizers on yield, fruit quality and nutritional status of "Wonderful" pomegranate trees, a field experiment was carried out in "Hegazi farm" located in Cairo to Alexandria desert road, Egypt. during three growing seasons 2016, 2017 and 2018 on nine years old pomegranate trees cv. 'Wonderful' growing in sandy loam soil under 62% shading. Nitrogen requirements were added from different combinations of commercial organic fertilizers such: Compost (COM), Chicken Manure (CHM), Cattle Manure (CAM) and Mineral Fertilizer (MF) by the rate 40 kg actual N $fed^{-1}$with or without humic acid addition. The experiment consists of ten treatments spread in a randomized complete block design with five replicates. Fertilizing with (50% (CHM)+ 50% (COM)), (50% (COM) + 50% (CAM) and (33.3% (CHM) + 33.3% COM) + 33.3% (CAM) + humic) enhanced vegetative growth, yield. Fertilizing with (50% (CHM) + 50% (COM) + humic) and (33.3% (CHM) +33.3% (COM) +33.3% (CAM) + humic) improved fruit physical properties like (arils weight, juice weight and juice volume). Fertilizing with, (50% (COM) + 50% (CAM) + humic) gave the highest content of TSS%, TSS/acid ratio & ascorbic acid and least content of acidity. So it could be recommended by, fertilizing "Wonderful" pomegranate trees by one of these treatments (50% CHM +50% COM + humic), (50% COM +50%CAM+ humic) and (33.3% CHM+33.3% COM+33.3% CAM +humic) by the rate of 40 kg actual N $fed^{-1}$to improve yield, fruit quality and nutritional status.

Keywords: Organic fertilizers combinations, Fruit quality, Leaf mineral content, Wonderful pomegranate trees, Productivity.

Introduction

Pomegranate (*Punica granatum*, L) has been mentioned in the Hallowed Quran and it was cultivated in Egypt a long time ago. Pomegranate is a popular fruit and considered one of the most valuable fruits for its nutritive, industrial and medicinal values. (Swain, 1965 and Nasacheva, 1973). Recently, in Egypt, pomegranate cultivated area increased rapidly from year to another and reached about 34.27 Hectare (85676 feddan) with total fruit production of 381426 metric tons, according to (M.A.L.R. R.2017). Fertilization plays an important role during the growing season to reach an economical yield with good fruit quality. In Egypt, usually apply mineral fertilizers especially nitrogen fertilizers in very excess quantities (Eman, 2006). Mineral fertilizers, pesticides and other chemicals used in production not only have great harmful effects on the environment but also they could change the composition of fruits and vegetables and harmful residues may remain in fruits (Bogatyre, 2000). Organic fertilizers became a promising alternative to mineral fertilizers to decrease of pollution and to produce more safe yield (Blake, 1990). Farmers apply organic N not only to improvement of soil physical, chemical and biological properties but also to increase in the availability of other nutrients (Yagodin, 1984, Lindemann & Cardenas, 1984, El-Salhy et al., 2002, Diab, 2006 and Almadini

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and Al-Gosaibi, 2007). Fertilizing by organic materials as N source has been considered as the best agricultural practice because organic N is released to the trees more gradually slow than water - soluble inorganic N fertilizers. Therefore, improving the efficiency of nutrient chemical and biological properties (Nijjar, 1985). The addition of organic fertilizers, such as (Chicken Manure, Cow Manure, Cattle Manure and etc.) or other agricultural wastes, contributes to the sustainability of agriculture systems and is always used to improve the soil structure, stability and to enhancing yield & quality of the plant (Tejada & Gonzalez, 2003, Gowda, 2007 Chang et al., 2010, Marzouk & Kassem, 2011 and Mansour, 2018).

There is little knowledge about the utilization of organic fertilizers in growing pomegranate and even less data on the best combinations between them which may be creating a better effect on pomegranate yield and fruit quality. So this present research was conducted to assess the effects of the addition of different combinations of commercial organic fertilizers named (Compost, Chicken Manure, Cattle Manure and humic) on yield, fruit quality and leaf mineral content of "Wonderful" Pomegranate trees.

Materials and Methods

A field experiment was carried out in three successive seasons (2016, 2017 and 2018) in "Hegazi farm" located in Cairo to Alexandria desert road, Egypt. Nine years old "Wonderful" pomegranate (*Punica granatum* L.) trees cultivated under 62% shading^{-1} at 2 × 5m apart irrigated by a drip irrigation system. Orchard soil was classified as sandy loam, analyzed according to Wilde et al. (1985). (ECe =7.90, pH = 8.21, dS/m, $CaCO_3$ =11.6%, N= 109.6 ppm, K= 107.0ppm and P= 27.3 ppm),

In this experiment trees nitrogen requirements were added from different combinations of commercial organic fertilizers such: Compost (COM), Chicken Manure (CHM), Cattle Manure (CAM) and Mineral Fertilizer (MF) by the rate 40 kg actual N fed^{-1} so each tree fertilized by (95.5 g actual N tree^{-1}season^{-1} with or without humic acid addition. The experiment consists of ten treatments spread in a randomized complete block design with five replicates for each treatment and each replicate was represented by one tree.

The experimental treatments arranged as follows:

T_1: 50% Chicken Manure +50% Compost +Humic

T_2: 50% Chicken Manure +50% Compost

T_3: 50% Chicken Manure +50% Cattle Manure Humic

T_4: 50% Chicken Manure +50% Cattle Manure

T_5: 50% Compost +50% Cattle Manure +Humic

T_6: 50% Compost +50% Cattle Manure

T_7: 33.3% Chicken Manure +33.3% Compost +33.3% Cattle Manure +Humic

T_8: 33.3% Chicken Manure +33.3% Compost +33.3% Cattle Manure

T_9: 100% Mineral N Fertilizer +Humic

T_{10}:100% Mineral N Fertilizer (control)

Different organic nitrogen combinations were weighted and mixed carefully then added once in the middle of February in every season as a ditch (30cm) under the drippers for each treated tree. Organic nitrogen fertilizers bought from the same source for each year, chemical analysis (average of three seasons) present in Table 1. Humic acid was added in three equal doses in the first week of each March, May and July by dissolving 50 g tree^{-1} season^{-1} (85% 1potassium humates) in one liter of water and applied it around the dripper. Treatments without humic acid were irrigated with water.

Mineral nitrogen fertilizers were injected through a drip irrigation system from common

TABLE 1. Chemical analysis of different organic fertilizers sources.

Properties	Chicken Manure	Compost	Cattle Manure
Weight of m3 (kg)	500.00	690.00	888.17
Moisture content %	22.30	33.60	20.84
pH value (1:10)	8.40	8.70	8.20
Ec value (1:10) (mmohs/cm)	5.20	6.30	4.20
Organic matter %	61.66	39.58	9.90
Total nitrogen (%)	2.68	1.55	1.30
C/N ratio	11.89	13.4	3.8
K (%)	0.88	1.24	0.93
P (%)	0.63	0.52	0.42

mineral nitrogen fertilizers like [ammonium sulfate (20.5%), calcium nitrate (15.5%) and ammonium nitrate (33.5%)] according to the growth stage through the growing season.

In the first season only, all treatments received biological nitrogen fertilizer consisted of a mixture of two local strains, (L4 and L_6) of *Azotobacter chroococcum*. One ml of this stock fresh liquid culture contained about ca. 16.0 x 10^8 cells. For all treatments, only one level of biological nitrogen fertilizer (500 ml /tree/year) diluted by water reached 1.5 liters was added as surface application one time in the first week of March.

The effect of the treatments mentioned above on productivity, fruit quality and mineral content in the three studied seasons was measured as follows:

Growth measurements

Twenty-five fully expanded leaves around 3 to 4- month- old (5-7th leaves) from plant top were collected in the second week of July to measure chlorophyll and leaf dry matter %. Chlorophyll content was measured by using a SPAD – 502 MINOLTA chlorophyll meter. Leaves samples were weighted (fresh weight) then washed with tap water followed by distilled water then oven-dried at 70˚C until a constant weight (dry weight) and then leaf dry matter % was calculated.

Yield

On the beginning of October (maturity stage) the average number of fruits / tree was taken. Twenty- five fruits from each replicate were taken to estimate the average fruit weight of each replicate. Such average was multiplied by the average number of fruits/tree to have the average yield/tree.

Fruit quality

For each season, a sample of five fruit/tree was taken for the determination of physical and chemical fruit properties:

A- Physical properties: Peel (thickness and weight), arils weight, juice (weight and volume) were determined and then estimated % of arils / fruit weight, juice/fruit weight and juice /arils weight.

B- chemical properties: The ascorbic acid content and total acidity (TA) was determined according to (AOAC 1984). The acidity percentage was calculated as mg anhydrous citric acid per 100 milliliters of juice. The total soluble solids (TSS) was determined using hand refractometer then calculated the TSS / Acid ratio.

Leaf mineral content

The above same sample of leaves were grounded then digested to determine some macronutrients such (N, P, K) by Micro-Kjeldahlmethod, spectrophotometer and flame photometer, respectively (Jackson, 1973) and some micronutrients such (Fe, Zn, Mn) by an atomic absorption according to the method of (Cottenie et al., 1982).

Statistical analysis

The obtained data were analyzed by ANOVA techniques using MSTAT Computer Software. The obtained data of three seasons were subjected to analysis of variance according to the means were differentiated using Duncan multiple range test at 5 % level (Duncan, 1955).

Results and Discussion

leaf chlorophyll content and leaf dry matter (%)

Results in Table 2 show, the effect of fertilizing with different combinations of organic fertilizers on chlorophyll content and leaf dry matter % during three growing seasons (2016, 2017 and 2018). Generally, results revealed that in the three seasons, chlorophyll content of pomegranate leaves was significantly affected by different treatments. In the three seasons, T_5, T_6, T_7 andT_8 gave the highest values of leaf chlorophyll content. On the other hand, T_{10} (control) gave the least values, especially in the second and third seasons.

Leaf dry matter percentage was significantly affected by different treatments in the first and third seasons only. Whereas, it could be noticed that T_7 (33.3% CHM +33.3% COM + 33.3% CAM +humic) gave the highest constant trend in three seasons.

In this respect, Moamen and El-Khawaga (2008) revealed that the application of organic nitrogen either alone or combined with mineral nitrogen source significantly improved vegetative growth traits of Zaghloul date palms.

Effect on pomegranate trees productivity

Results in Table 3 present, the effect of fertilizing with different combinations of organic fertilizers on fruit weight, fruit number and yield of pomegranate trees during three growing seasons (2016, 2017 and 2018).

A- Fruit weight: fruit weight in the three seasons were significantly affected by organic treatments. Generally, in the three seasons, T_1, T_2, T_3 and T_7 gave the highest values of fruit weight. On the other hand, mineral treatments (T_9 and T_{10})

TABLE 2. Efficacy of fertilizing with different combinations of organic fertilizers on leaf chlorophyll content and leaf dry matter percentage of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	Leaf chlorophyll (SPAD)			Leaf dry matter %		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1:50% CHM*+50%COM**+Humic	65.2a-d	61.3ab	66.5b-d	47.6c	46.5a	47.0a
T_2: 50%CHM+50%COM	58.59d	56.9b	60.5e	48.9bc	34.5a	34.2b
T_3: 50%CHM+50%CAM***+Humic	64.4b-d	56.7b	63.9c-e	51.9a-c	37.6a	35.0b
T_4: 50%CHM+50%CAM	63.9b-d	64.1ab	63.2de	49.7bc	37.0a	34.9b
T_5: 50%COM+50%CAM+Humic	68.2a-c	60.6ab	68.5a-c	50.9bc	43.9a	45.7a
T_6: 50%COM+50%CAM	69.1a-c	59.4ab	67.4a-d	47.4c	37.6a	35.3b
T_7:33.3%CHM+33.3%COM+33.3%CAM+Humic	71.2a	62.9ab	72.3a	55.4a	46.2a	46.0a
T_8: 33.3%CHM+33.3%COM+33.3%CAM	69.5ab	68.4a	70.5ab	50.6bc	37.1a	36.5b
T_9: 100%MF**** +Humic	62.3cd	58.7ab	62.2de	47.3c	39.8a	40.7ab
T_{10}: 100%MF (control)	67.9a-c	54.1b	61.0e	53.3ab	35.6a	35.2b

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level

gave the least values of fruit weight, especially in the second and third seasons.

B- Fruit number /tree: In three seasons fruit number was affect significantly by different treatments, in most cases, it was noticed that T_1, T_2, T_5, T_6, T_7 and T_8 gave the highest significant values than other treatments especially in the first two seasons.

C- Yield: In the three seasons (Table 3), yield was affected significantly by treatments whereas, all organic manure combinations except T_3 andT_4 improved yield compared with mineral treatments (T_9 and T_{10})

So, it is concluded that the highest values of growth measurements parameters (leaf dry matter & chlorophyll content), yield and parameters (fruit weight & fruit numbers) were obtained when fertilizing pomegranate trees with (50% CHM + 50% COM with or without humic), (50% COM + 50% CAM with or without humic) and (33.3% CHM + 33.3% COM +33.3% CAM +humic) these treatments gave the highest values than other organic and mineral treatments. This impact might have been due to the improvement of nutrients uptake preferred by the application of organic fertilizers.

These results are in harmony with those obtained by Shahein et al. (2003) and El-Assar (2005) found that the yield of Samany and Zaghloul date palms was great as a result of fertilizing with organic-N source either alone or combined with mineral nitrogen sources. Otherwise, the highest bunch weight was gained by the application of organic-N fertilizers only, whereas, the least bunch weight related to fertilizing by mineral sources. Islam et al. (2017) proved that, application of mixed organic manures consisting of 10kg cowdung and 1kg mustard oilcake or 10kg poultry manure along with recommended mineral fertilizers gave higher yield with high quality of sweet orange (BARI Malta 1) rather than the alone recommended mineral fertilizers or only cowdung with recommended mineral fertilizers. Therefore, for better yield and quality production of BARI Malta 1 mixed organic manure consisting of cowdung and mustard oilcake or poultry manure along with recommended mineral fertilizers could be suggested. On apple trees Kopytko et al. (2017) observed that, according to the increase in soil productivity under a long-term about the 83-year period of growing experimental, at the end of experiment apple fruit-bearing increased approximately 31−41% under organic fertilizers system compared with 21–23% under mineral fertilizer system.

Fruit physical properties

Results in Table 4 show, the effect of fertilizing with different combinations of organic fertilizers on fruit physical properties of Wonderful pomegranate trees during three growing seasons (2016, 2017 and 2018).

Peel weight was affected significantly by organic treatments in the second and third seasons only and mineral fertilizer treatment + humic (T_9) gave the lowest significant values. Other treatments gave more or less similar values with the same statistical standpoint.

Peel thickness was affected significantly by organic combinations treatments in the first two seasons, the highest significant value was obtained by T_3 especially in the second season. On the other hand, T_9 (mineral fertilizer treatment + humic) gave the least values whereas, other treatments gave more or less similar values without any significant difference between them, especially in the second season.

Arils weight was affected significantly by organic combinations treatments in the first and third seasons only, the highest constant trend was noticed by treatment T_7 (33.3%CHM+33.3%COM+33.3%CAM +humic). Contrary, T_9 (mineral fertilizer +humic) gave the least values, especially in the first and third seasons.

It seems that juice weight was affected significantly by organic combinations treatments in the first and third seasons only, whereas, treatment T_1(50% CHM+50%COM+humic) gave the highest values of juice weight followed closely by T_7(33.3% CHM + 33.3% COM + 33.3% CAM + humic) in the three seasons. On the other hand, the least values were obtained by T_4 (50% CHM + 50% CAM) followed by T_9 (100% Mineral Fertilizer +humic), especially in the second and third seasons.

Regarding juice volume, it was affected significantly by different treatments in the three growing seasons. Treatment T_1 gave the highest significant values of juice weight especially in the first and second seasons followed by T_2 and T_7 treatments. In most cases, the least values were observed by T_3, T_4, T_9 and T_{10} treatments.

The results summarized in, T_1(50% CHM + 50% COM+ humic) and T_7(33.3% CHM + 33.3% COM+33.3%CAM +humic) treatments gave the highest values of most fruit physical properties especially (arils weight, juice weight and juice

TABLE 3. Efficacy of fertilizing with different combinations of organic fertilizers on fruit weight, fruit number /tree and yield of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	Fruit weight (g)			Fruits number /tree			Yield (kg /tree)		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1:50% CHM*+50%COM**+Humic	610.0a	548.3a	506.7ab	59.6ab	62.7ab	69.7a	36.2a	34.2a	35.3a
T_2: 50%CHM+50%COM	602.2ab	460.9a-c	530.0ab	59.7ab	65.7ab	58.3b-d	35.9a	30.3a-c	31.0a-d
T_3: 50%CHM+50%CAM***+Humic	541.1a-e	463.3a-c	555.6ab	46.3cd	45.3d	42.0e	25.0cd	21.6d	23.2 cd
T_4: 50%CHM+50%CAM	503.3de	397.5bc	553.3ab	51.9bc	58.3bc	49.0c-e	26.1cd	23.2b-d	21.1d
T_5: 50%COM+50%CAM+Humic	540.0a-e	471.7a-c	452.2b	67.0a	69.0a	67.3ab	36.1a	32.6a	30.4a-d
T_6: 50%COM+50%CAM	527.8b-e	450.8a-c	554.4ab	67.0a	69.3a	59.3bc	35.3a	31.1ab	32.9ab
T_7:33.3%CHM+33.3%COM+33.3%CAM+Humic	585.6a-c	494.2ab	648.9a	60.7ab	67.7a	55.0cd	35.5a	33.4a	35.0a
T_8: 33.3%CHM+33.3%COM+33.3%CAM	522.2c-e	424.2bc	537.8ab	59.2ab	64.0ab	58.3b-d	30.9b	27.2a-d	31.5a-c
T_9: 100%M F**** +Humic	480.0e	366.7c	480.0b	56.2b	61.7ab	52.0c-e	26.8c	22.6cd	24.9b-d
$T1_0$: 100%MF (control)	558.9a-d	420.8bc	493.3b	40.9d	52.0cd	48.3de	22.5d	21.9d	23.8cd

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level

TABLE 4. Efficacy of fertilizing with different combinations of organic fertilizers on fruit physical properties of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	Peel weight(g)			Peel thickness (mm)			Arils weight(g)			Juice weight (g)			Juice volume (ml)		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1: 50% CHM*+ 50% COM**+ Humic	251.7a	245.6a	219.4ab	7.43a	4.90bc	4.69a	350.6a	237.8a	255.0ab	257.2a	162.8a	206.7a	254.4a	158.3a	181.1ab
T_2: 50%CHM+ 50% COM	236.7a	182.1ab	273.9a	7.40a	5.03bc	6.40a	281.1b	217.5a	220.6b	201.1b	143.3a	172.2ab	191.1bc	146.5ab	163.3ab
T_3: 50%CHM+ 50% CAM***+ Humic	240.3a	212.1ab	281.7a	5.72c	6.49a	6.36a	262.8b	181.7a	237.2ab	182.2b	122.8a	150.0b	172.2c	118.9ab	150.0 b
T_4: 50%CHM+ 50% CAM	226.7a	169.4ab	272.8a	7.57a	3.91cd	4.70a	272.8b	181.1a	240.0ab	199.4b	116.7a	147.8b	182.2bc	113.3b	151.7 ab
T_5: 50%COM+ 50%CAM+ Humic	218.9a	217.2ab	232.8ab	6.87a-c	5.35b	6.26a	266.1b	206.1a	221.8b	197.2b	135.6a	172.3ab	201.1bc	131.1ab	157.8ab
T_6: 50%COM+ 50%CAM	235.6a	214.4ab	283.3a	6.40a-c	3.87cd	5.10a	242.8b	212.8a	226.1b	183.3b	153.3a	152.8b	173.3c	142.2ab	140.0b
T_7: 33.3%CHM+33.3% COM+33.3% CAM+ Humic	252.2a	201.7ab	285.6a	7.29ab	4.58b-d	5.01a	298.9ab	220.6a	296.1a	226.7ab	148.3a	207.2a	213.3b	143.3ab	192.2a
T_8: 33.3%CHM+33.3% COM+33.3% CAM	246.1a	185.6ab	255.6ab	6.92a-c	5.01bc	5.25a	251.1b	187.8a	210.0b	188.9b	127.8a	145.6b	178.9c	135.6ab	161.1ab
T_9: 100% MF****+ Humic	211.1a	148.3b	168.3b	5.90bc	3.52d	5.42a	242.8b	189.4a	208.3b	178.9b	122.2a	152.2b	176.7c	136.1ab	155.6ab
T_{10}: 100% MF (control)	248.9a	178.9ab	217.8ab	6.37a-c	3.57d	5.22a	262.2b	187.8a	226.1b	187.2b	133.3a	159.4b	174.4c	131.1ab	148.9ab

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level

volume). Nevertheless, T_9(100% Mineral Fertilizer +humic) and T_{10} (100% Mineral) gave the least values of fruit physical properties.

From Table 5, it could be observed that arils/fruit percentage affected significantly by different treatments in three growing seasons. On the other hand, juice/fruit and juice/arils percentages affected significantly by treatments in the first and third seasons only. In most cases, T_1 (50% CHM+ 50%COM + humic) treatment gave the highest values of all fruit physical properties percentage in the three growing seasons. Other treatments were lacked significance on the physical properties percentage in the three growing seasons.

Fruit chemical properties

Results in Table 6 present, the effect of fertilizing by different combinations of organic fertilizers on fruit chemical properties of Wonderful pomegranate trees during three growing seasons (2016, 2017 and 2018).

It seems that TSS was significantly affected by organic combinations treatments in the three seasons. Generally, the least significant values were obtained by T_7 (33.3% CHM + 33.3% COM + 33.3% CAM +humic), T_8 (33.3% CHM + 33.3% COM + 33.3% CAM) and T_{10} (control) treatments in the three growing seasons. Nevertheless, treatment T_5 (50% COM + 50% CAM+ humic) gave the highest values of TSS% during the three growing seasons followed closely by T_1, T_2 and T_4 treatments, especially in the first and third seasons.

Acidity was significantly affected by organic treatments in the second season only, whereas. The least significant values were obtained by T_5, T_6 and T_{10} treatments. Otherwise, T_4, T_7 and T_9 gave the highest values of acidity during the three growing seasons.

TSS/acid ratio significantly affected by different organic treatments in the second and third seasons only, otherwise T_2, T_3 and T_5 gave the highest values of the TSS/acid ratio during the three growing seasons. On the other hand, T_7 and T_9 treatments gave the least significant values of the TSS/acid ratio, especially in the second two seasons.

Ascorbic acid was significantly affected by organic treatments in the first and third seasons only. Whereas, T_1 and T_5 gave the highest values of ascorbic acid during the three seasons followed by T_7 and T_8 but in the first two seasons.

Form the above results, it could be concluded that, T_5 (50% COM + 50% CAM + humic) treatment gave the highest values of TSS%, TSS/acid ratio & ascorbic acid. On the other hand, T_5 (50% COM + 50% CAM + humic) treatment gave the least values of acidity. Other organic treatments gave more or less similar values with the same statically standpoint but in most cases higher than mineral Fertilizer treatments especially T_{10} (control).

In this respect, Lu et al. (2003) revealed that fertilizing with organic manure enhanced the quality of apple fruits by improving the peel color, increasing firmness and TSS content. in addition, Moamen and El-Khawaga (2008) observed that the application of organic nitrogen either alone or combined with mineral nitrogen source significantly increased yield of Zaghloul date palms and improved the quality of the date as compared to application of mineral nitrogen alone. Otherwise, saving cost and reducing environmental pollution. the same results were pointed out by Liu and Liu (2012) on pineapple whereas, enhancement in the fruit chemical characteristics, especially TSS, total sugars, the ratio of total sugar and titratable acid with the addition of organic manure. The sensory evaluation also indicated that the pineapple fruits fertilized with organic manure were better in fragrance and sensory than the control. Regarding humic acid addition, Samra et al. (2017) pointed out that, fertilizing Washington navel orange trees with humic acid and fulvic acid as a soil application had no clear effect on average fruit weight, fruit juice, SSC, total acidity and SSC/acid ratio than the control. On the other hand, treated by 30 ml humic with 100 ml fulvic acid gave a somewhat increment on ascorbic acid in fruit juice.

Effect on leaf macronutrients content

Results in Table 7 present, the effect of fertilizing by different combinations of organic fertilizers on leaf macronutrients content of Wonderful pomegranate trees during three growing seasons (2016, 2017 and 2018).

TABLE 5. Efficacy of fertilizing with different combinations of organic fertilizers on some fruit physical properties percentage of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	Arils /fruit (%)			Juice/fruit (%)			Juice /arils (%)		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1:50% CHM*+50%COM**+Humic	57.5a	43.0ab	50.2a	42.2a	29.5a	41.0a	73.3b-e	68.6a	82.7a
T_2: 50%CHM+50%COM	46.8b	47.3ab	41.6c	33.4b	31.1a	32.6bc	71.7de	65.7a	78.1ab
T_3: 50%CHM+50%CAM***+Humic	48.6ab	40.0b	43.0bc	33.7b	27.0a	27.5c	69.4f	67.5a	63.9c
T_4: 50%CHM+50%CAM	54.4ab	45.6ab	43.4a-c	39.8ab	29.3a	27.0c	73.1c-e	64.2a	62.2c
T_5: 50%COM+50%CAM+Humic	49.3ab	43.8ab	49.1ab	36.6ab	28.8a	38.3ab	74.3a-c	66.0a	77.9ab
T_6: 50%COM+50%CAM	46.0ab	47.0ab	40.9c	34.7b	33.7a	27.7c	75.5ab	71.5a	67.6bc
T_7:33.3%CHM+33.3%COM+33.3%CAM+Humic	51.1ab	44.3ab	46.1a-c	38.8ab	29.7a	32.4bc	75.9a	67.0a	70.3a-c
T_8: 33.3%CHM+33.3%COM+33.3%CAM	47.9ab	44.4ab	39.1c	36.0ab	30.2a	27.1c	75.2a-c	68.0a	68.9bc
T_9: 100%MF**** +Humic	50.7ab	52.0a	43.4a-c	37.4ab	33.4a	31.7bc	73.7a-d	64.5a	73.4a-c
T_{10}: 100%MF (control)	46.6b	44.7ab	45.9a-c	33.2b	31.8a	32.4bc	71.3ef	71.2a	70.5a-c

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level.

Results indicated that nitrogen content was significantly affected by different treatments in the three growing seasons. It was clear that the least significant values of nitrogen content were obtained by T_9(100%mineral Fertilizer + humic) in the first season and T_3 (50%CHM + 50%CAM + humic) in the second and third seasons. Other treatments gave more or less similar values from the statistical standpoint.

Concerning, phosphorus content the results showed that P content was significantly affected by different treatments in the first and third seasons only. it was observed that the trend was varied slightly from the three seasons. Nevertheless, T_1 (50% CHM + 50% COM + humic) treatment gave the highest values of phosphorus content during the three growing seasons.

Potassium content was significantly affected by different treatments in three seasons. The trend was varied slight from season to another. The least values of K content were obtained by T_4 and T_5 in the first seasons and by T_8 in the second and third seasons. On the other hand, the highest values of K content were taken by T_9 in the first season and by T_1, T_5 and T_7 in the third season.

From the above results in general, T_1 (50% CHM +50% COM + humic) treatment gave the highest values of (N, P and K content. Other organic and mineral treatments gave more or less similar values of (N, P and K content) from the statistical standpoint.

This could be explained by, (Kaurch et al., 2005) reported that adding organic manures enhanced soil properties and fertility and may be lead to an increase in available nutrients. Organic manures addition might have provided supplemental exchangeable cations like Ca, K, Mg, ammonium and increasing available P (Magdoff 1988). Nevertheless, Gasparatos et al. (2011) pointed out that, the results did not provide evidence of major differences in the leaf macronutrient content (NPK) between conventionally and organically grown apple trees.

Effect on leaf micronutrients content

Results in Table 8 showed that, the effect of fertilizing by different combinations of organic fertilizers on Fe, Zn and Mn content in leaves of wonderful pomegranates trees during three growing seasons (2016, 2017 and 2018).

Results concerning, iron content was affected significantly by different treatments in the first season only whereas; the least significant values of iron content were obtained by T_{10} (100% MF) followed by T_9 (100% MF + humic). Other treatments gave more or less similar values with a slightly significant difference between them.

The Values of zinc content were insignificantly affected by different treatments in the three growing seasons.

Results revealed that manganese content was significantly affected by different treatments in the three seasons. T_5 (50% COM + 50% CAM + humic) gave the highest values of manganese content in pomegranate leaves during the three growing seasons. Other treatments gave more or less similar values.

In this respect, the good efficiency of organic manures may be due to the fact that the organic manures would have provided with some micronutrients like Zn, Cu, Fe, Mn, and Mg at an optimum level. Fertilizing with organic manures helped in the plant metabolic activity through the supply of such essential micronutrients in early vigorous growth (Anburani and Manivannan 2002).

Conclusion and Recommendation

Concerning the above observation, it could be recommended by, fertilizing "Wonderful" pomegranate trees with one of these treatments (50% CHM +50% COM + humic), (50%COM +50%CAM+ humic) and (33.3% CHM + 33.3% COM + 33.3% CAM + humic) by the rate of 40 kg actual N $fed^{-1}$to improve yield, fruit quality and nutritional status.

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TABLE 6. Efficacy of fertilizing with different combinations of organic fertilizers on chemical properties of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	TSS %			Acidity %			TSS / acid ratio			Ascorbic acid (mg/ 100ml juice)		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1: 50% CHM*+ 50% COM**+ Humic	16.5a	14.8cd	17.6ab	1.06a	0.953b-d	1.47a	15.9a	15.7b-d	12.43c	10.3a-c	9.67a	10.8a-c
T_2: 50% CHM+ 50% COM	16.2a-c	14.8cd	17.3ab	1.06a	0.864c-e	0.832a	15.3a	17.1a-d	21.63ab	9.00cd	9.50a	10.2a-d
T_3: 50% CHM+ 50% CAM***+ Humic	16.3ab	15.0bc	16.8bc	0.935a	0.818de	0.640a	17.5a	18.5ab	27.07a	8.67d	9.33a	7.80e
T_4: 50% CHM+ 50% CAM	16.2a-c	14.7cd	16.9a-c	1.09a	1.02a-c	1.11a	15.4a	14.5cd	17.22bc	9.67b-d	10.0a	8.10de
T_5: 50% COM+ 50% CAM+ Humic	16.5a	15.3a-c	17.8a	0.965a	0.740e	0.725a	17.2a	20.8a	25.75a	11.00ab	10.0a	12.00a
T_6: 50% COM+ 50% CAM	16.0a-c	15.6ab	15.8d	1.01a	0.775e	1.17a	16.0a	20.6a	14.28bc	9.33cd	9.67a	11.57bc
T_7: 33.3% CHM+ 33.3% COM + 33.3% CAM+ Humic	15.4bc	14.5cd	16.2cd	1.16a	1.05ab	1.54a	13.6a	13.8d	10.58c	11.33a	9.67a	10.58c
T_8: 33.3% CHM+ 33.3% COM+ 33.3% CAM	15.2c	14.8cd	14.5e	0.945a	0.839de	0.917a	16.5a	17.7a-c	15.9bc	10.00a-d	9.67a	9.00c-e
T_9: 100% MF****+ Humic	16.1a-c	15.8a	15.3de	0.964a	1.14a	1.41a	17.6a	14.0cd	11.0c	9.67b-d	9.00a	9.00c-e
T_{10}: 100% MF (control)	15.4bc	14.0d	15.8d	0.967a	0.725e	0.917a	15.9a	19.5ab	17.3bc	9.00cd	8.33a	9.60b-e

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan´s multiple range test, 5% level

TABLE 7. Efficacy of fertilizing with different combinations of organic fertilizers on N, P and K content in leaves of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons .

Treatments	N%			P%			K%		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1:50% CHM*+50%COM**+Humic	1.80ab	1.58ab	1.84a	0.211a-d	0.215a	0.225a	0.616b	0.593a	0.679a
T_2: 50%CHM+50%COM	1.54ab	1.49ab	1.62a-c	0.203a-d	0.155a	0.168h	0.624b	0.530ab	0.546b
T_3: 50%CHM+50%CAM***+Humic	1.58ab	1.24b	1.40c	0.153d	0.175a	0.188c	0.515bc	0.507ab	0.468c
T_4: 50%CHM+50%CAM	1.67ab	1.51ab	1.54a-c	0.164b-d	0.146a	0.180d	0.491c	0.593a	0.515bc
T_5: 50%COM+50%CAM+Humic	1.86ab	1.58ab	1.67a-c	0.194a-d	0.183a	0.203b	0.491c	0.624a	0.671a
T_6: 50%COM+50%CAM	1.69ab	1.67a	1.49bc	0.224ab	0.199a	0.173f	0.538bc	0.538ab	0.507bc
T_7:33.3%CHM+33.3%COM+33.3%CAM+Humic	1.75ab	1.58ab	1.62a-c	0.242a	0.150a	0.180d	0.577bc	0.585a	0.624a
T_8: 33.3%CHM+33.3%COM+33.3%CAM	1.97a	1.56ab	1.80ab	0.215a-c	0.164a	0.171g	0.546bc	0.437b	0.468c
T_9: 100%MF**** +Humic	1.49b	1.49ab	1.62a-c	0.160cd	0.178a	0.177e	0.741a	0.530ab	0.515bc

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level

TABLE 8. Efficacy of fertilizing with different combinations of organic fertilizers on Fe, Zn and Mn content in leaves of Wonderful pomegranate trees during 2016, 2017 and 2018 seasons.

Treatments	Fe (ppm)			Zn (ppm)			Mn (ppm)		
	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season	2016 season	2017 season	2018 season
T_1:50% CHM*+50%COM**+Humic	80.0a-c	81.6a	91.6a	27.2a	23.9a	22.2a	82.0b	80.2a-c	80.8bc
T_2: 50%CHM+50%COM	88.0ab	74.3a	65.0a	21.2a	23.5a	18.2a	75.7b	72.8cd	77.1cd
T_3: 50%CHM+50%CAM***+Humic	98.2a	79.7a	61.6a	18.9a	21.7a	19.2a	79.0b	78.7bc	75.7c-e
T_4: 50%CHM+50%CAM	64.7bc	70.0a	75.0a	20.1a	18.8a	16.2a	76.4b	68.0d	73.3de
T_5: 50%COM+50%CAM+Humic	81.5a-c	85.7a	85.0a	23.7a	24.7a	21.2a	94.0a	87.5a	90.7a
T_6: 50%COM+50%CAM	77.2a-c	80.7a	70.0a	19.7a	16.2a	20.2a	74.8b	74.8cd	69.8e
T_7:33.3%CHM+33.3%COM+33.3%CAM+Humic	76.4a-c	83.0a	87.0a	20.0a	23.8a	20.2a	83.2b	85.6ab	86.4ab
T_8: 33.3%CHM+33.3%COM+33.3%CAM	86.9a-c	86.9a	80.8a	20.5a	20.4a	18.2a	76.8b	79.8a-c	71.8de
T_9: 100%MF****+Humic	69.7bc	80.0a	77.0a	20.2a	20.0a	19.2a	75.4b	77.8bc	72.8de
T_{10}: 100%MF (control)	63.0c	80.1a	80.0a	19.7a	19.6a	18.2a	79.8b	77.8bc	72.8de

*CHM: Chicken Manure **COM: Compost ***CAM: Cattle Manure MF****: Mineral Fertilizer

Values having the same letters in the same column in each season are not statistically different by Duncan ´s multiple range test, 5% level

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«تقييم كفاءة بعض توليفات الاسمدة العضوية علي الانتاجية وجودة الثمار والحالة الغذائية لرمان "الوندررفول"

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أجريت تجربة حقلية مزرعة حجازي بالطريق الصحرواي مصر – اسكندرية خلال ثلاثة مواسم متتالية ٢٠١٦،٢٠١٧،٢٠١٨ علي اشجار رمان صنف وندرفول عمر تسعة سنوات نامية تحت ظروف تظليل ٦٢٪ وذلك بهدف تقييم كفاءة استخدام توليفات مختلفة من بعض الاسمدة العضوية التجارية علي المحصول وجودة الثمار والحالة الغذائية لرمان "وندرفول". وقد تم اضافة الاحتياجات السمادية النتروجنية للاشجار من خلال التوليفات المختلفة لبعض انواع الاسمدة العضوية التجارية (كمبوست،سماد دواجن،سماد ماشية) بجانب معاملة السمادى المعدني واضيف النتروجين بمعدل ٤٠ كجم / فدان / سنة مع او بدون أضافة حمض الهيوميك وعلي ذلك احتوت التجربة علي عشرة معاملات وزعت في قطاعات كاملة العشوائية ومثلت كل معاملة بخمسة مكررات . وأوضحت النتائج ان التسميد بـ (٥٠٪ دواجن+ ٥٠٪ كمبوست) ، (٥٠٪ كمبوست + ٥٠٪ ماشية) ، (٣٣,٣٪ كمبوست + ٣٣,٣٪ دواجن + ٣٣,٣٪ ماشية + هيوميك) شجعت النمو الخضرى وأدت الى زيادة المحصول. في حين أن المعاملات (٥٠٪ دواجن+ ٥٠٪ كمبوست+ هيوميك) ، (٣٣,٣٪ كمبوست + ٣٣,٣٪ دواجن + ٣٣,٣٪ ماشية+ هيوميك) أدت الى تحسين الصفات الفيزيائية للثمار كـ (وزن الحبات ، وزن وحجم العصير) أما التسميد بـ (٥٠٪ كمبوست + ٥٠٪ ماشية + هيوميك) أعطى أعلي محتوي للمواد الصلبة الذائبة وأقل حموضة وعلي ذلك يمكن التوصية بتسميد الرمان عضويا بأحد المعاملات الاتية ٥٠٪ دواجن+ ٥٠٪ كمبوست+هيوميك) ، (٥٠٪ كمبوست + ٥٠٪ ماشية + هيوميك) ، (٣٣,٣٪ كمبوست + ٣٣,٣٪ دواجن + ٣٣,٣٪ ماشية+ هيوميك) بمعدل ٤٠ كجم / فدان / سنة .