Using some Organic Manure Sources and Biofertilizers to Improve Growth and Productivity of Manfalouty Pomegranate Trees

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ABSTRACT

The current investigation was executed at in a private the Orchard, located at El-Grayb Sahel Selim district, Assiut Governorate, Egypt, to study the effect of different organic manure sources and bio-form fertilizers on growth and fruiting of Manfalouty pomegranate trees during 2021 and 2022 seasons. The experiment was arranged in a complete randomized block design with four replications and it consisted of nine treatments, including fertilizing trees with 50% of mineral nitrogen, phosphorus and potassium, and the other 50% being given in the form of organic fertilizer, chicken manure, compost, cattle manure, or sugar cane vinasse, with or without bio fertilization. The results can be summarized as follow:

1- All fertilization treatments improved growth, leaf total chlorophyll and nutritional status as soon as yield and fruit quality of Manfalouty pomegranate trees.
2- Using 50 % of the recommended dose of mineral nitrogen, phosphorus and potassium + chicken manure with bio fertilizers treatment was a superior whereas, it significantly increased the shoot length, leaf area, chlorophyll and contents of N, P and K in leaves compared to mineral-N source only (check treatment).
3- All organic and bio fertilizers treatments significantly increased the yield/tree and commercial fruit % and significantly decreased the fruit splitting and sunburn percentage compared to use check treatment.
4- Fertilization with any thrice form (mineral + organic + bio) significantly improved the fruit properties by increasing the fruit weight, arils percentage and total soluble solids as well as sugar, anthocyanin and vitamin C contents and decreasing the total acidity compared to use the check treatment. It is clear from the current results the importance of fertilization through organic and bio-form for pomegranates productivity, via improve the fruit quality which reflects on induce the increase packable yield. In addition, such fertilization treatments reduce environmental pollution.

Key words: bio-fertilization, organic, pomegranate yield, nutrient status, fruiting.

INTRODUCTION

Pomegranate (*Punica granatum* L.) economically is important commercial fruit plant species belonging to family Punicaceae. The tree is tolerant drought, hard winter and can grow well under the stress of desert conditions. The whole tree parts including the fruits are using for treating many diseases, i.e. diarrhea, hyperacidity, tuberculosis, leprosy, abdominal pain and fever. Due to its multipurpose medicinal uses it is also known as "Dadima" in Ayurveda (Paranjpe, 2001) and as "super fruit" in the global functional food industry (Martins et al., 2006). Juices of pomegranates have antioxidants i.e. polyphenols, tannins and anthocyanins, hence can be used to control of cancer and chronic inflammation (Michel et al., 2005 and Ephraim and Robert, 2007).

The total area of pomegranate trees were estimated to be about 0.5% of the total fruit acreage in Egypt (76924 feddans). Assiut Governorate is considered the main producer of Egyptian pomegranate according to

M.A.L.R.(2020). Recently, there has been an increasing demand for pomegranate (*Punica granatum* L.) to meet the need of local as well as the foreign markets of some European and Arabic countries.

Growth, nutritional status, yield and fruiting of pomegranate trees significantly effects by fertilization (Hunter et al., 2011 and Srivastava and Malhotra, 2017), one of the most important is fertilizing with nitrogen because it is an essential component of acids, chlorophyll and many phytohormones may studies have confirmed that its deficiency has many symptoms and a negative impact on growth, yield and fruit quality (Marschner, 2012). The efficiency of nitrogen fertilization ranges between 30 and 40% under field and surface irrigation conditions (Saharawat, 1979). The nitrogen loss by leaching, volatilization, denitrification is considered the most important problem in the Egyptian soils. Hence, the N applied sources management is required to solve this problem. Currently, there is great interest to solve this problem in terms of reducing chemical fertilizers used to reduce cost and avoid its harmful effects.

Organic fertilization has several benefits, as an increase the activity of micro flora, soil structure aggregation, soil organic matter, water holding capacity, soil humus content and the availability of most nutrients. This beneficial affects lead to increase the nutrients absorption, improve the biosynthesis of organic foods and cell division (Miller et al., 1990).

Therefore, attention should be paid to modern methods and innovative techniques of fertilization methods and horticultural practices. Thus using of organic and bio-fertilization, which affects raising the fertilization efficiency, increasing the growth and yield and improving the fruit quality (El-Salhy et al., 2015 and Amin et al., 2017).

Production of horticultural crops has undergone significant changes in recent years due to development of innovative technologies including integrated nutrient management practices. The application of organic fertilizers is a production system that avoids or largely excludes the use of synthetic chemical fertilizers. Bio-fertilizers, which include phosphate-solubilizing bacteria (PSBs), symbiotic and non-symbiotic, N_2-fixing bacteria and arbuscularmycorrhizal (AM) fungi. The use of organic and bio-fertilizers on enhancing plant growth and yield has gained momentum in recent years because of higher cost and hazardous effect of chemical fertilizers (Khanizadeh et al., 1995).

Replacing the chemical fertilizer with organic and bio-fertilizers that depend on the recycling of farm residues and animal manure that increase soil fertility and facilitate absorption nutrients are the best alternative for avoiding all forms of pollution that may result from conventional agriculture techniques (Miller et al., 1990 and Yagodin, 1990; Eman, Abd-Ella et al., 2010 and El-Salhy et al., 2015). Importantly the previous reports found that they improve the growth and fruit quality of pomegranate (Wardee, 2007; El-Salhy et al., 2015; Amin et al., 2017 and El-Salhy et al., 2022).

So, this investigation was planned to study the effect of some organic fertilizers sources and bio-fertilization on growth and fruiting of Manfalouty pomegranate trees as a trial to reduce the costs of fertilizers fertilization and environmental pollution as well as finding out the best ratio of mineral, organic and bio-fertilizers used.

MATERIALS AND METHODS

This study carried out during the two successive seasons of 2021 and 2022 on Manfalouty pomegranate trees grown at a private Orchard located at El-Grayb Sahel Selim distinct, Assiut Governorate, Egypt, where the soil has a sandy texture and its properties were presented in Table (1), according to Wilde et al., (1985).

Table (1): Some physical and chemical properties of soil (0-60 cm deep) of the experimental site.

Soil property	Value	Soil property	Value
Sand (%)	91.51	Organic matter (%)	0.32
Silt (%)	4.56	Total nitrogen (%)	0.16
Clay (%)	3.93	P (ppm)	21.6
Texture grade	Sandy	K (ppm)	401.3
pH (1-2.5)	8.22	Fe (ppm)	2.31
EC (ds m^{-1})	3.69	Zn (ppm)	2.15
$CaCO_3$ (%)	8.66	Mn (ppm)	2.43

Thirty six healthy trees, 18 years old with no visual nutrient deficiency symptoms were chosen and devoted for carrying out this experiment. The chosen trees received the same horticulture practices excepted fertilization treatments. Nine fertilization treatments were arranged as follows:

T1- Applying 100 % of the recommended mineral NPK dose (2 kg ammonium nitrate 33.3 % N +1Kg potassium sulphate +100 cm^3 phosphoric acid /tree /season) as the control treatment.

T2- Applying 50% mineral NPK (1 kg ammonium nitrate 33.3 % N +0.5 Kg potassium sulphate + 50 cm^3 phosphoric acid /tree/season) + 50 % organic as a source of chicken manure (12 kg / tree / season).

T3- T2 + 150 cm^3 of Azotobacter chroococcum, B. megaterium and B. circulans in equal doses.

T4- Applying 50% mineral NPK + 50% organic as a source of compost (22 kg/ tree/season).

T5- T4 + 150 cm^3 of Azotobacterc hroococcum, B. megaterium, and B. circulans in equal doses.

T6- Applying 50% mineral NPK + 50% organic as a source of cattle manure (25 kg/tree/season).

T7- T6 + 150 cm^3 of Azotobacter chroococcum, B. megaterium, and B. circulans in equal doses.

T8- Applying 50% mineral NPK + 50 % organic as a source of Vinasse (11 kg /tree/ season).

T9- T8 + 150 cm^3 of Azotobacter chroococcum, B. megaterium, and B. circulans in equal doses.

The experiment was set up as a randomized complete block design with four replications per treatment, one tree each. Organic manure sources (chicken manure, compost, cattle manure and sugar can vinasse) were added once in the first week of December in each season as a trench (30 cm diameter and 40 cm depth at the distance of 50 cm) under the drippers for each selected tree.The amount of organic fertilizer added was calculated from the fertilizer sources used in this study on the basis of the percentage of nitrogen in each fertilizer and according to the Tables 2 & 3 and to achieve 660 g N/tree every season. All organic manure sources obtained from the same place for each season, chemical analysis (average of three seasons) of the organic fertilizers was presented in Tables(2 & 3).

Table (2). Characteristics of different organic fertilizers sources.

Properties	Chicken manure	Compost	Cattle manure
Weight of m^3(kg)	445.00	670.00	915.22
Moisture content (%)	25.28	36.12	23.14
pH value (1:10)	8.45	8.58	8.76
EC value (1:10) (mmohs/cm)	5.88	6.53	4.46
Organic matter (%)	58.61	35.96	8.92
Total nitrogen (%)	2.80	1.50	1.30
C/N ratio	11.89	13.38	3.80
K (%)	0.90	1.33	0.92
P (%)	0.56	0.48	0.38

Table (3). Characteristics of sugar can vinasse organic fertilizer.

Organic matter	pH value (1:10)	Total nitrogen (%)	K (%)	P (%)	Na (%)	Fe mg/kg	Zn mg/kg	Mn mg/kg
29	4.5	3.0	6.1	0.05	2.6	260	60	60

Bio-fertilizers preparation; liquid cultures of the three bacteria: Azotobacter chroococcum, Bacillus megaterium, and Bacillus circulans. It is produced by the Biofertilizers Unit, Faculty of Agriculture, Ain Shams University. Each organism was grown separately in a batch culture to the late exponential stage of each microorganism to give a cell suspension of 5 × 105, 6 × 107, and 4 × 107 cell/ml for Azotobacter chroococcum, B. megaterium, and B. circulans, respectively. The cultures were mixed on site in equal doses to form one liter of biofertilizer and added in two equal batches at growth start and one month later. It used by mixing with moist sand before the application, added in soil holes around the trunk of the tree and then, directly irrigated after covering the holes with soil.

Mineral fertilizers treatments were added through drip irrigation system from different sources {ammonium nitrate (33.5% N), potassium sulphate (48 % K_2O)} according tothe growth stage through the growing season while phosphorus was added in the source of phosphoric acid during the growth season.

The following parameters were measured during the three studied seasons.

A- Vegetative growth

Four main branches almost nearly in growth and distribution in four sides of tree were selected and labeled in April for the following vegetative measurements:

1- Shoot length (cm).
2- Number of leaves/shoot.
3- Leaf area (cm^2), was estimated as according to Ahmed and Morsy (1999).

B- Leaf total chlorophyll and nutritional status of leaves:

1- Leaf total chlorophyll was estimated by using chlorophyll meter (Minolta SPAD 502 plus). Using ten leaves from the fourth terminal expended leaf of the shoot.
2- Nutritional status of leaves: Samples of fifty mature leaves were randomly selected from the non-fruiting spring shoots on mid-September to determine N, P and K in leaves using the digestion with a mixture of sulfuric acid and hydrogen peroxide (Wilde et al., 1985). Nitrogen was measured by the micro-Kjeldahl methods (Bremner and Mulvaney, 1982), phosphorus and potassium were determined by colorimetricaly and flame photometer, respectively (Jackson, 1958).

C- Yield and its components:

Fruits were harvested and yield/tree was recorded. The defective fruits was separated to estimate the percentage of splitting, sun burning fruits and commercial fruits.

D- Fruit quality: For each season, sample of 10 fruit / tree were randomly taken for the evaluation of physical and chemical fruit properties:

1- The fruit weight and arils % were determined
2- The total soluble solids (TSS) were determined as % in juice by means of hand refractometer.
3- Total acidity was determined by titrating10 ml of juice with 0.1 mol/L NaOH to pH 8.1 (A.O.A.C. 1984). The acidity percentage was calculated as mg anhydrous citric acid per100 milliliters of juice total acidity (expressed as g citric acid/100 ml juice).
4- The ascorbic acid content was determined by using 2, 6 dichlorophenol indophenol dye and 3% oxalic acid as substrate. Ascorbic acid was calculated

as milligrams/100 milliliters of juice (A.O.A.C. 1995)

5- Reducing sugar was determined according to A.O.A.C. methods (1995).
6- The total anthocyanin content of the juice was calculated according to Rabino and Mancinelli (1986**)**.

Statistical analysis

The obtained data were statistically analyzed by using the analysis of variance as reported by (Snedecor and Cochran, 1972). Means were differentiated by using Duncan's multiple range tests at 5 (%) (Duncan, 1955).

RESULTS AND DISCUSSIONS

1- Effect of different organic fertilization sources and biofertilizers on vegetative growth:

Data presented in Table (4) showed the effect of different organic fertilization sources on shoot length, number of leaves/shoot and leaf area of Manfalouty pomegranate trees during 2021 and 2022 seasons.

Data showed that shoot length, number of leaves/shoot and leaf area significantly affected by using various sources of organic fertilization compared to use the recommended dose of fertilizers only (check treatment). All fertilization treatments significantly increased shoot length, number of leaves/shoot and leaf area compared to use mineral sources only (T_1). Moreover, using 50% minerals NPK + 50% organic as a source of chicken manure plus biofertlizers (T_3) gave the highest shoot, number of leaves/ shoot and leaf area compared with the check treatment (T_1). Regarding of shoot length, the highest values (63.35 and 66.81) were achieved with fertilized trees by using 50% minerals NPK + 50% organic as a source of chicken manure plus biofertlizers (T_3) while the least values (56.61 and 59.33) recorded for trees fertilized by using the recommended dose of nitrogen (RND) only (check treatment) in both studied seasons, respectively. No significant differences were obtained due to fertilization via either 50% mineral-N plus 50 % organic as chicken manure (T_2) or 50 % mineral plus 50% organic as compost (T_4) or 50% mineral-plus 50 % organic as cattle manure + biofertilizers (T_7)or 50% mineral plus 50% organic as Vinasse (T_8) and 50% mineral-plus 50 % organic as Vinasse + biofertilizers (T_9).Concerning the number of leaves / shoot, the highest values (34.28 and 36.59) and leaf area (8.88 and 8.92) were recorded with fertilized trees by using 50% minerals NPK + 50% organic as a source of chicken manure plus biofertlizers (T_3) while the least values of number of leaves / shoot (18.6 and 20.10) and leaf area (6.83 and 7.38) recorded for trees fertilized with the recommended dose of fertilizers only (check treatment) during 2021 and 2022 seasons, respectively. These results may be due to the beneficial effects of organic fertilizers in increasing the availability of most nutrients and improving physical and chemical properties of soil in favour of increasing nutritional status and tree growth could explain the present results for the necessity of using organic with mineral fertilizer (Nijjar, 1985 and Miller et al., 1990). In addition, microorganisms produce growth promoting substances that increase plant growth resulting in an increased rate of photosynthesis (Nardi et al., 2002). Organic and bio-fertilization should be used while reducing the use of chemical nitrogen fertilizers, as well as, their safety for soil, human, animals and environment (Verma, 1990; Mosa et al., 2014; El-Salhy et al., 2015 and Amin et al., 2017). The enhancing effect of using organic matter on both plant metabolism and plant growth has been extensively studied by (Tan and Tantiwiramanond, 1983; and Chen

andAviad, 1990). The results came in agreement with many researchers who worked on the effect of organic matter and the reduction of mineral fertilizers (Fernandez-Escobar et al.,1996 and Abou El-Khashab et al.,2005) on olive, (Abo Taleb, 2004) on pecan, (Gowda, 2007) on fig; (Eman, Abdel Monem et al.,2008) on grapevine and (Noha, Mansour 2018) on pomegranate

Table (4): Effect of different organic fertilization sources and biofertilizers on shoot length, number of leaves / shoot and leaf area of Manfalouty pomegranate trees during 2021 and 2022 seasons.

Characteristics		Shoot length (cm)		No. of leaves /shoot		Leaf area (cm^2)	
Treatments \ Season		2021	2022	2021	2022	2021	2022
T_1	100% min. NPK (control)	56.61 C	59.33 C	18.6 E	20.10 F	6.83 C	7.38 C
T2	50% min. NPK + 50% organic : chicken manure	60.46 AB	63.58 AB	33.17 AB	34.27 BC	8.31 AB	8.71 AB
T3	T2 + biofertilizers	63.35 A	66.81 A	34.28 A	36.59 A	8.88 A	8.92 A
T4	50% min. NPK + 50 % organic : compost	61.19 AB	64.31 AB	32.13 BC	33.44 CD	7.98 AB	8.45 AB
T5	T4 + biofertilizers	63.44 A	65.25 AB	34.08 AB	36.01 AB	8.52 AB	8.87 A
T6	50% min. NPK + 50% organic : cattle manure	59.69 BC	62.85 B	29.55 D	30.77 E	7.66 BC	8.34 B
T7	T6 + biofertilizers	61.28 AB	63.97 AB	31.12 CD	33.46 CD	7.88 B	8.58 AB
T8	50% min. NPK + 50% organic : Vinasse	62.15 AB	64.54 AB	30.57 CD	31.28 DE	7.82 B	8.64 AB
T9	T8 + biofertilizers	62.31 AB	65.12 AB	32.18 BC	33.87 BC	8.11 AB	8.93 A

In each season, means having the same letters are not significantly different at 5% level.

2- Effect of different organic fertilization sources and biofertilizers on leaf total chlorophyll and nutritional status:

Data presented in Tables (5) showed the effect of different organic fertilization sources and biofertilizers on total chlorophyll and the percentage of N, P and K in leaves during 2021 and 2022 seasons.

Data showed that total chlorophyll (SPAD value) and the percentage of N, P and K in leaves significantly affected by various sources of organic fertilization and biofertilzers compared to use the recommended dose of fertilizers only (check treatment). All fertilization treatments significantly increased the percentage of leaf total chlorophyll, N, P and K in leaves compared to use mineral sources only (T_1) in both seasons, whereas 100 % of the recommended NPK alone had the lowest values comparing with other treatments. In the meantime, leaf total chlorophyll values were increased with fertilized trees with 50 % of the recommended rate of NPK plus 50% organic manure as the source of chicken manure + biofrtilizers (T3) and its values were (61.96 and 62.53) in both seasons. Leaf nitrogen content was significantly increased by all treatments which contained organic manure and biofertilizers as compared with mineral fertilizer alone (T1) during the two seasons. Leaf P content increased by adding compost at rate of 22 kg /tree or chicken manure at rate of 12 kg/tree mixing with 50% of the recommended rate of NPK plus biofertilizers in the first and second seasons. As for leaf K content, NPK fertilizers when applied alone (T1) at the full dose gave the lowest values while the half dose and mixed with either chicken manure or vinasse with biofertilizers produced the richest leaves in K content in the 2021 and 2022 seasons. The use of organic and biological fertilizers results in

positive effects such as improving the bio-activity, increasing the nutrients absorption and improving the fertilization efficiency. They also, improves the nutritional status of trees in terms of building nutrients, carbohydrates and proteins, which leads to a balance between nutrients and the synthesis of carbohydrates in plant (Subba Rao, 1984 and Kannaiyan, 2002). This effect can be attributed to the effect of organic matter which is able to stimulate root development, elongation and to increase the production of thin and lateral roots, this enhancement could be due to the availability of nutrients in root-zone; and moreover, the gradual increase of leaf nutrients is also due to the plant growth (Noha Mansour,2018).The obtained data were also in agreement with Abou El-Khashab et al., (2005); Hosam El-Dein and Boshra (2008); EmanAbd-Ella et al., (2010); Abedel-Sattar, et al.,(2011).

Table (5): Effect of different organic fertilization sources and biofertilizers on total chlorophyll (SAPD value) and N, P and K percentage of Manfalouty pomegranate leaves during 2021 and 2022 seasons.

Characteristics		Total chlorophyll (SAPD value)		N (%)		P (%)		K (%)	
Treatments \ Season		2021	2022	2021	2022	2021	2022	2021	2022
T_1	100% min. NPK (control)	56.69 C	57.34 C	1.69 D	1.64 D	0.299 D	0.291 D	1.24 D	1.22 D
T2	50% min. NPK + 50% organic: chicken manure	60.12 AB	61.03 AB	1.82 AB	1.75 A-C	0.375 B	0.365 AB	1.38 AB	1.35 AB
T3	T2 + biofertilizers	61.96 A	62.53 A	1.86 A	1.80 AB	0.396 A	0.382 A	1.39 A	1.36 A
T4	50% min. NPK + 50 % organic : compost	59.89 AB	60.75 AB	1.81 AB	1.77 A-C	0.368 B	0.354 A-C	1.34 BC	1.31 C
T5	T4 + biofertilizers	61.78 A	62.11 AB	1.85 A	1.81 A	0.370 B	0.362 AB	1.35 A-C	1.33 BC
T6	50% min. NPK + 50% organic : cattle manure	58.96 BC	59.62 BC	1.70 CD	1.72 C	0.338 C	0.331C	1.33 C	1.35 AB
T7	T6 + biofertilizers	59.85 AB	60.49 AB	1.76 BC	1.74 BC	0.342 C	0.341 BC	1.35 A-C	1.36 A
T8	50% min. NPK + 50% organic : Vinasse	60.33 AB	61.08 AB	1.76 BC	1.72 C	0.356 BC	0.348 BC	1.35 A-C	1.36 A
T9	T8 + biofertilizers	61.13 AB	61.49 AB	1.78 B	1.74 BC	0.362 B	0.355 A-C	1.38AB	1.37 A

In each season, means having the same letters are not significantly different at 5% level.

3- Effect of different organic fertilization sources and biofertilizers on yield (kg/ tree), and percentage of fruit splitting, sunburn and commercial fruits.

As for the effect of organic and mineral fertilizer NPK whether alone or in combinations with biofertilizers, it is clear from Table (6) that yield (kg/tree) and commercial fruits were significantly increased with application of all treatments comparing with the control treatment in both seasons. On the other hand these fertilization treatments significantly decreased the fruit splitting and sunburn percentage compared to mineral-NPK sources only (T1). Whereas, application of 50% of the recommended rate of NPK either with chicken manure at 12 kg / tree or compost at 22 kg/tree or vinasse at 11 kg / tree plus biofertilizers (T3, T5 and T9) gave significantly the highest yield and highest percentage of commercial fruits than most of other treatments and the differences among the three treatments weren't significant in both seasons while treatment T1 (100 % minerals NPK) gave the lowest yield and the percentage of commercial fruits compared to the other treatment in both seasons. The percentage of splitting and

fruits sunburn were significantly decreased by all the organic manure with or without biofertilizers treatments as compared with mineral fertilization (T1) in both seasons (Table 6), the percentage of fruit splitting and sunburn were significantly decreased by using 50 % of the recommended rate of NPK mixing with chicken manure or compost or vinasse plus biofertilizers (T3, T5 and T9). Meanwhile, on the other hand, the highest percentages of fruit splitting and sunburn were recorded from trees fertilized with the NPK recommended rate (T1) in both seasons. Therefore, it is clear that fertilization with a mixture of three sources (organic + bio + mineral) fertilizer have beneficial effects on the pomegranate production. This apparent effect may be attributed to the positive effect of mixed mineral fertilizers with organic and biofertilizers which reserved the sufficient amounts of N, P and K for plant development (Rosa et al., 2004). Moreover, the addition of organic fertilizers and bio-fertilizers to the soil promoted the proliferation of soil microorganisms, increased microbial populations and activity of microbial enzymes such as dehydrogenase, urease and nitrogenase (Maggioni et al., 1987). These results are consistent with those obtained by Safia (2004), Saleh et al., (2006), Eman et al., (2008) and Salama et al., (2012).

Table (6): Effect of different organic fertilization sources and biofertilizers on yield/tree (kg) and percentage of fruit splitting, sunburn and commercial fruits of Manfalouty pomegranate trees during 2021 and 2022 seasons.

Characteristics		Yield (kg/tree)		Fruit splitting (%)		Sunburn (%)		Commercial fruits (%)	
Treatments \ Season		2021	2022	2021	2022	2021	2022	2021	2022
T_1	100% min. NPK (control)	88.64 D	90.18 D	11.64 A	12.11 A	22.18 A	23.31 A	66.18 D	64.58 D
T2	50% min. NPK + 50% organic : chicken manure	102.68 AB	105.61 AB	6.11 D	6.37 CD	12.64 CD	13.79 CD	81.25 A	79.84 AB
T3	T2 + biofertilizers	104.35 A	107.75 A	6.05 D	6.12 D	12.25 D	12.07 D	81.70 A	81.81 A
T4	50% min. NPK + 50 % organic : compost	101.97 AB	104.42 A-C	6.31CD	6.45 CD	12.97 CD	13.62 CD	80.72 AB	79.93 AB
T5	T4 + biofertilizers	103.11 AB	105.64 AB	6.08 D	6.13 D	12.21 D	12.28 D	81.71 A	81.59 A
T6	50% min. NPK + 50% organic : cattle manure	98.75 C	102.28 BC	7.76 B	8.10 B	15.75 B	16.71 B	76.49 C	75.19 C
T7	T6 + biofertilizers	103.12 AB	104.89 AB	7.10 BC	7.64 BC	14.83 BC	15.68 BC	78.07 BC	76.68 BC
T8	50% min. NPK + 50% organic : Vinasse	100.15BC	101.28 BC	6.49 CD	6.38 CD	13.69 B-D	14.33 CD	79.82 AB	79.29 AB
T9	T8 + biofertilizers	102.33 AB	103.86 BC	6.25 CD	6.16 D	12.92 CD	13.57 CD	80.83 AB	80.27 A

In each season, means having the same letters are not significantly different at 5% level.

3- Effect of different organic sources fertilization and biofertilizers on fruit quality:

It is noticed from the obtained data presented in Tables (7 to 8) that the fertilization with mineral-NPK plus organic with or without bio fertilizer significantly improved the fruit quality in terms of increasing the fruit weight, arils percentage and their contents of total soluble solids, reducing sugar and anthocyanin and V.C contents and decreasing the total acidity compared to use the recommended minerals NPK dose only.

It is obvious that fruit weight (g), Aril % and TSS (Table 7) were significantly increased by all the studied treatments comparing with the control. The same trend was found in reducing sugars, anthocyanin and vitamin **C** (Table 8). Trees fertilized

with 50% of NPK plus chicken manure or compost with or without bio fertilizers where the differences were too low to be significant. Acidity however showed an opposite trend. It should be noted that the effect of 50% of the recommended rate of NPK + chicken manure or compost plus bio fertilizers (T 3 and T 5) were more pronounced than the other treatments and the differences between them were not significant followed by 50% of the recommended rate of NPK +chicken manure or with compost without bio fertilizers (T2 and T4). The previous improvement in pomegranate yield and fruit characteristics may be attributed to the synergistic effect of the combination between mineral amendments, organic and bio fertilizers. The recorded fruit weight values were 430.3 and 441, arils percentage were 59.8 and 60.2, TSS % were 15.86 and 15.53 due to T_3 during the first and second seasons, respectively.

The corresponding values of reducing sugars were 13.83 and 13.63 %; anthocyanin contents were 60.20 and 61.60 and vitamin C values were 27.81 and 28.31 when fertilized trees with 50 % NPK mixed with chicken manure plus bio fertilizers (T3) during both studied seasons, respectively followed by the treatment included application trees with 50 % of recommended NPK plus compost with bio fertilizers. These fertilization programs are very important for the production of pomegranate fruits, because improving the quality of fruits leads an increase in packable yield. In addition, such fertilization treatments reduce the production cost and environmental pollution producing by mineral fertilization. This is due to the improvement of the chemical and physical properties of the soil and available nutrients which in turn improve plant growth and fruit production and quality (Li, 1999). The finding of many investigators gave a real support to our findings, Saleh et al., (2006), Naik and Sriharibabu (2007) and Eman, Abdel monem et al., (2008) Eman, Abd-Ella et al ., (2010). El-Salhy et al., (2015), Amin et al., (2017) and El-Salhy et al., (2022)

Table (7): Effect of different organic fertilization sources on fruit weight (g) Arils % and TSS % of Manfalouty pomegranates during 2020, 2021 and 2022 seasons.

Characteristics		Fruit weight (g)		Arils %		TSS %	
Treatments \ Season		2021	2022	2021	2022	2021	2022
T_1	100% min. NPK (control)	383.9 E	394.2 D	54.8 D	55.1 D	15.10 D	14.75 D
T2	50% min. NPK + 50% organic: chicken manure	427.6 AB	439.1 A	59.6 AB	59.9 AB	15.81 A-C	15.43 BC
T3	T2 + biofertilizers	430.3 A	441.0 A	59.8 A	60.2 A	15.86 A	15.53 A
T4	50% min. NPK + 50 % organic : compost	424.3 A-C	434.9 A	59.3 A-C	59.6 A-C	15.80 A-C	15.46 A-C
T5	T4 + biofertilizers	428.1 AB	437.8 A	58.2 BC	58.5 A-C	15.82 AB	15.51 AB
T6	50% min. NPK + 50% organic : cattle manure	408.4 D	418.8 C	58.0 C	58.1 C	15.75 C	15.40 C
T7	T6 + biofertilizers	415.5 CD	425.5 B	58.3 A-C	58.4 BC	15.77 BC	15.48 A-C
T8	50% min. NPK + 50% organic : Vinasse	419.3 BC	420.2 BC	58.1 BC	58.4 BC	15.78 BC	15.40 C
T9	T8 + biofertilizers	422.1 A-C	425.3 B	58.8 A-C	59.2 A-C	15.80 A-C	15.44 A-C

In each season, means having the same letters are not significantly different at 5% level.

Table (8): Effect of different nitrogen fertilization sources on reducing sugars %, anthocyanin mg/100g and vitamin C (mg/100g) and acidity % of Manfalouty pomegranate juice during 2020, 2021 and 2022 seasons.

Characteristics		Reducing sugars %		Anthocyanin mg/100g		Vitamin C (mg/100g)		Acidity %	
Treatments \ Season		2021	2022	2021	2022	2021	2022	2021	2022
T_1	100% min. NPK (control)	13.11 C	12.95 C	48.94 D	50.11 D	22.64 F	23.10 E	1.36 A	1.41 A
T2	50% min. NPK + 50% organic: chicken manure	13.82 A	13.60 A	60.10 A	61.42 A	27.30 A-C	27.78 AB	1.12 CD	1.15 E
T3	T2 + biofertilizers	13.83 A	13.63 A	60.20 A	61.60 A	27.81A	28.31 A	1.11 D	1.14 E
T4	50% min. NPK + 50 % organic : compost	13.75 AB	13.58 A	56.37 BC	57.73 BC	26.06 B-D	26.63 BC	1.19 B	1.23 B
T5	T4 + biofertilizers	13.78 AB	13.59 A	58.18 AB	59.53 AB	27.54 AB	28.28 A	1.12 CD	1.15 E
T6	50% min. NPK + 50% organic : cattle manure	13.65 B	13.49 B	56.01 C	56.23 C	24.35 E	24.88 D	1.19 BC	1.21 C
T7	T6 + biofertilizers	13.71 AB	13.56 AB	56.72 BC	56.02 C	25.16 DE	26.03 CD	1.16 BC	1.18 D
T8	50% min. NPK + 50% organic : Vinasse	13.78 AB	13.55 AB	55.22 C	56.61 C	25.89 CD	27.11 A-C	1.17 B	1.20 C
T9	T8 + biofertilizers	13.79 AB	13.61 A	56.13 BC	58.00 BC	26.02 B-D	26.13 CD	1.15 B-D	1.18 D

In each season, means having the same letters are not significantly different at 5% level.

Conclusion

Therefore, it could be concluded that use of 50 % of the recommended NPK plus either chicken manure or compost organic fertilization sources with bio fertilizers improved the tree growth, nutrients status, yield and fruit quality and leading to an increase in the marketable yield, as well as minimize environmental pollution which could be occurred by excess use of chemical fertilizers. These advantages will eventually enable growers to obtain high yield with good fruit quality. Furthermore, use of organic and bio-fertilization sources improves the soil fertility and reduces the added fertilizer requirements.

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استخدام بعض مصادر الأسمدة العضوية و الحيوية لتحسين نمو وإنتاجية أشجار الرمان المنفلوطي

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أجريت هذه الدراسة خلال موسمين متتاليين ٢٠٢١، ٢٠٢٢ بمزرعة خاصة بمنطقةالغريب–ساحل سليم – محافظة أسيوط – مصر،لدراسة تأثير إضافة مصادر مختلفة من الأسمدة العضوية والحيوية علي النمو الخضري والحالة الغذائية والمحصول وخصائص ثمار أشجار الرمان المنفلوطي مقارنة بإضافة الأسمدة المعدنية فقط. حيث تم إضافة الأسمدة المعدنية علي ثلاثة دفعات (مارس – مايو – أغسطس) بينما أضيفت الأسمدة العضوية مرة واحدة خلال شهر ديسمبر والأسمدة الحيوية مرتين في بداية النمو وبعد شهر.تم تصميم التجربة بنظام القطاعات العشوائية الكاملة في تسعة معاملات وكل معاملة تمثلت بأربعة مكررات وكانت المعاملات عبارة عن تسميد الأشجار بنسبة ٥٠٪ من الاسمدة المعدنية وهي النيتروجين والفوسفور والبوتاسيوم، أما الـ ٥٠٪ الأخرى كانت على شكل سماد عضوي وهي سماد الدواجن، أو السماد العضوي الكمبوست أو روث الماشية أو فيناس قصب السكر مع أو بدون التسميد الحيوي.

ويمكن تلخيص النتائج على النحو التالي:

١- أدت جميع معاملات التسميد إلى تحسين النمو ومحتوي الاوراق من الكلوروفيل والعناصر الغذائية بالإضافة الي تحسن محصول أشجار الرمان المنفلوطي وجودة الثمار.

٢- كان أستخدام ٥٠٪ من الجرعة الموصي بها من الاسمدة المعدنية وهي النيتروجين والفوسفور والبوتاسيوم + سماد الدواجن مع إضافة الأسمدة الحيوية هي المعاملة المتفوقة حيث أدت إلى زيادة طول الأفرع ومساحة الأوراق ومحتوي الأوراق من الكلوروفيل والنيتروجين والفوسفور والبوتاسيوم في الأوراق مقارنة بمعاملة الكنترول والتي كانت عبارة عن ١٠٠ % من الكمية الموصي بها من الاسمدة المعدنية (النتروجين – الفوسفور – البوتاسيوم).

٣- أدت معاملات التسميد العضوي والحيوي إلي زيادة محصول الاشجار والثمار التجارية كما قلت نسبة الثمار التي حدث بها تشقق أو لسعة الشمس بالمقارنة بمعاملة الكنترول ١٠٠ % من الأسمدة المعدنية.

٤- وجد أن تسميد الاشجار بالأسمدة المعدنية والعضوية والحيوية في اي من صور الأسمدة العضوية المستخدمة أدي الي التحسين المعنوي في خصائص الثمار الطبيعية والكيماوية من حيث زيادة وزن الثمرة ونسبة الحبوب وإجمالي المواد الصلبة الذائبة وكذلك محتوى السكر والأنثوسيانين وفيتامين ج وتقليل الحموضة الكلية مقارنة باستخدام معاملة الكنترول.

٥- يتضح من النتائج الحالية أهمية التسميد العضوي والحيوي لإنتاجية الرمان من خلال تحسين جودة الثمار مما ينعكس على زيادة المحصول القابل للتعبئة؛ بالإضافة إلى ذلك، فإن معاملات التسميد المستخدمة قد قللت من تلوث البيئة.