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(Original Article)

Effect of Mepiquat Chloride, Ammonium Nitrate and Seaweed Extracts on Yield and Chemical Properties of Manfalouti Pomegranate Cultivar

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Abstract

The current study examined the effects of ammonium nitrate, seaweed extract, and mepiquat chloride on the yield and fruit quality of Manfalouti pomegranates during the 2023 and 2024 growing seasons. This study studied the effects of three distinct chemical compounds on yield and fruit quality of Manfalouty Pomegranate cultivar grown under Assiut climatic conditions. The greatest increase in the number of fruits per tree and total yield weight was observed when seaweed extract was applied at rates of 2, 4, and 1%. According to the current study, seaweed extract improves fruit's chemical properties and yield component.

Keywords: *Ammonium nitrate, Mepiquat chloride, pomegranate, Seaweed extract, Yield.*

Introduction

One of the best fruits in tropical and subtropical climates is the pomegranate (*Punica granatum* L.), a member of the Punicaceae family. Originating in Iran, the fruit has long been grown throughout the Mediterranean, particularly in Spain, Morocco, Egypt, and Afghanistan (Sheikh and Manjula, 2012). Sugars, vitamins, carbohydrates, polyphenols, and minerals are abundant in pomegranate arils, the fruit's edible part (Melgarejo and Artıes, 2000; Ferrara *et al*., 2014). The seeds contain a good amount of oil and are high in CLA (Ferrara *et al*., 2014), while the fruit skins and membranes are rich in ellagitannins, which have a variety of health-promoting bioactivities (Seeram *et al*., 2006).

The Ministry of Agriculture's 2023 figures show that 83278 Fedden was the total area used for pomegranates in 2023, while 77130 Fedden was used for fruiting. This resulted in an average of 11.455 tonnes per fedden, or approximately 883540 tonnes.

The most significant pomegranate cultivar that has been successfully cultivated in Egypt is Manfalouty, a native variety. It has been grown for its medicinal, decorative, and economic qualities. Pomegranate fruits are typically consumed fresh or turned into syrup all over the world. It is distinguished by its appealing colour and pleasant acidic flavour. (Abd El-Hamed and El-Desouky, 2014).

The availability of nitrogen (N) has a significant impact on agricultural productivity and plant growth. Nitrate, nitrite, and ammonium are among the inorganic forms of nitrogen that plants consume in natural soils. While ammonium can be a

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dominating form of nitrogen in certain acidic and/or anaerobic settings, nitrate is the primary form of nitrogen in the majority of aerated soils (Miller and Cramer, 2004). Although its content in soil is often lower than that of nitrate and ammonium, nitrite availability varies in soils around the world based on the balance between nitrification and denitrification (Shen I., 2003; Kotur *et al*., 2013).Urea, amino acids, and peptides are among the sources of organic nitrogen that plants can take (Kojima *et al*., 2007; Tegeder and Rentsch, 2010; Forde, 2014). The amounts of amino acids that plants can access in boreal environments can be similar to those of inorganic nitrogen (Näsholm *et al*., 2009). Since N availability in natural settings frequently restricts plant growth, plants have evolved transport and signalling systems unique to their individual N sources (Kiba and Krapp, 2016).

In order to enhance nutritional status, vegetative growth, yield, and fruit quality in various orchards, seaweed extract is used as a biostimulant that contains N, P, K, Ca, Mg, and S as well as Zn, Fe, Mn, Cu, MO, and Co. It also contains some growth regulators, polyamines, and vitamins (Abd El-Moniem and Abd-Allah 2008).

Since over 15 million tonnes of seaweed extracts are utilised each year in agricult ural fields across the globe, they are regarded as one of the organic sources used (FAO 2006).

According to Kerby (1985), Constable (1995), and Osterhuis and Egilla (1996), mepiquat chloride (MC) is useful for regulating plant structure in situations that encourage vegetative development, which is useful for yield and quality. Increased fruit abscission, decreased production, and more shade beneath the plant canopy are the outcomes of excessive vegetative growth (Guinn, 1974). When MC is used, the plant becomes shorter and more compact, its leaf area index decreases because the leaves are smaller (Reddy et al., 1990), and it matures earlier (York, 1983, Kerby, 1985).

By interfering with hormonal regulating systems, MC alters plant structure. Finding the best MC schedules is challenging since these processes react complexly to plant density and growing circumstances.

This study looked at the effects of three chemical compounds, mepiquat chloride, ammonium nitrate, and seaweed extract on yield and fruit quality of Manfalouty Pomegranate cultivar grown under Assiut climatic conditions.

Materials and Methods

This study carried out during two successive seasons of 2023 and 2024 on Thirty 45 - years old Manfalouty pomegranate trees grown at the experimental orchard of faculty of agriculture, Assiut University, Egypt. The soil texture is clay and well drained and water table is not less than two meters deep. Surface irrigation system was followed by using the Nile water. The trees are spaced at 5.0 meters' x 5.0 meters (168 trees / fedden). The selected trees (30 trees) were chosen as uniform in vigor as possible and devoted to achieving this study. The chosen trees were pruned during the last week of December in both seasons.

The treatment categories were

1- Control

2- Spraying with Ammonium nitrate at 100 ppm.

3- Spraying with Ammonium nitrate at 200 ppm.

4- Spraying with Ammonium nitrate at 400 ppm.

5- Spraying with seaweed extract at 1%.

6- Spraying with seaweed extract at 2%.

7- Spraying with seaweed extract at 3%.

8- Spraying with Mepiquat chloride at 100 ppm.

9- Spraying with Mepiquat chloride at 200 ppm.

10- Spraying with Mepiquat chloride at 400 ppm.

Experiment was setup as a randomized complete blocked design (RCBD)(10×3) with three replications for each treatment and one tree per each. The analysis of variance (ANOVA) was applied using Proc Mixed of SAS package version 9.2 (SAS, 2008) and means were compared by using the revised L.S.D. values at 5% level of the probability (Steel and Torrie, 1981).

Different measurements

- yield (kg).
- Fruit.no/tree
- TSS%.
- Reducing sugars % (Lane and Eynon, 1965).
- Total acidity % (as g citric acid/100 ml juice) (A.O.A.C.,2000).
- TSS/ acid ratio

The plant extracts were prepared by the procedure described by (Fuleki and Francis 1968). The anthocyanin content was expressed as mg of cyaniding-3-glucoside equivalent per 100 mg of dry sample weight.

The anthocyanin content (AC) was calculated according to the following equation (Rabino and Mancinelli, 1986)

$$\text{A.C.} = \frac{\text{Absorbance} \times 449.2 \times \text{Dilution factor}}{29600 \times \text{sample weight}}$$

Where: 29600 = molar extinction coefficient.

449.2 = molecular weight of C.3.g.

Dilution factor = final volume / initial volume.

Results

1. Yield components

- Total number of fruits/ tree

The study showed that during the 1st season of study, seaweed extract and Mepiquat chloride significantly exceeded the control and Ammonium nitrate concerning the total number of fruits/ tree. On the other side, the differences between Ammonium nitrate and control were not significant. While in the 2nd season of study, seaweed extract at 2% and 4% and Mepiquat chloride at 400 ppm and seaweed extract at 1% exhibited an increment percentage of 27.72%, 26.55%, 23.35% and 22.57% over the control, respectively.

- Yield weight (kg/tree)

Treatments impact on total yield weight (kg/tree) is shown in Table 1.

The study showed that the treatments with the exception of Ammonium nitrate, significantly exceeded the control. The results showed that, during the 1st season of study, the highest yield (kg/tree) was obtained from seaweed extract at 2, 4 and 1%. The increment percentages of such treatments were 65.09, 64.79 and 51.11% over the control, respectively. During the 2nd season of study, it could be observed same trend of the 1st season where such treatments recorded 51.01%, 50.29 and 43.84% over the control, respectively. Two seasons average data of the same treatments gave 57.69, 57.15 and 47.29% over the control, respectively.

Table 1. Effect of ammonium nitrate, seaweed extract and mepiquat chloride on fruit.no/tree and yield of Manfalouty pomegranate cultivar during 2023 and 2024 seasons.

Treatment	Fruit.no/tree			yield		
	2023	2024	mean	2023	2024	mean
Control	191.33 E	194.4 C	192.86 D	68.85 F	76.65 F	72.75 G
Ammonium Nitrate 100 ppm	194.97 E	201.64 C	198.31 D	73.44 E	83.4 E	78.42 F
Ammonium Nitrate 200 ppm	191.11 E	197.07 C	194.09 D	74.7 E	82.08 E	78.39 F
Ammonium Nitrate 400 ppm	194.04 E	199.73 C	196.88 D	77.64 E	83.58 E	80.61 F
Seaweed Extracts 1%	247.85 B	238.29 A	243.07 B	104.04 B	110.25 B	107.15 B
Seaweed Extracts 2%	262.03 A	248.76 A	255.40 A	113.67 A	115.77 A	114.72 A
Seaweed Extracts 4%	256.4 AB	246.02 A	251.21 A	113.46 A	115.2 A	114.33 A
Mepiquat Chloride 100 ppm	208.96 D	215.56 B	212.27 C	84.63 D	90.69 D	87.66 E
Mepiquat Chloride 200 ppm	211.0 D	224.93 B	217.97 C	87.84 D	96.00 C	91.92 D
Mepiquat Chloride 400 ppm	231.06 C	239.81 A	235.43 B	96.66 C	109.86 B	103.26 C

The treatments that took the same letters within column are not significantly different according to LSD at 5% level of probability.

2. Chemical constituents

Table 2 and 3 showing the effect of treatments on fruit chemical traits of Manfalouty pomegranate cultivars during 2023 and 2024 seasons of study.

- Total soluble solids (TSS%)

Data presented in Table 2 revealed that, generally, there are few differences between most of the treatments concerning this characteristic.

During the 1st season of study, seaweed extract at 4% recorded the highest TSS (17.11%). During the 2nd season, the differences between the treatments were not significant. Two seasons average data revealed that, seaweed extract at 4% gave the best results (17.16%) followed by seaweed extract at 2% (17.05%) and then seaweed extract at 1% (17.03%).

- Acidity (%)

During the two seasons of study, table (2) showed that control recorded the highest percentage of acidity, while seaweed extract treatments recorded the lowest one (0.34%).

- TSS/ acid ratio

Table (2) showed that, during the 1st season, seaweed extract at 4% recorded the highest ratio followed by Mepiquat chloride treatments, with significant differences between them. During the 2nd season of study, seaweed extract at 4% significantly exceeds the rest of treatments.

Table 2. Effect of ammonium nitrate, seaweed extract and mepiquat chloride on TSS%, acidity% and Tss/acid ratio of Manfalouty pomegranate cultivar during 2023 and 2024 seasons.

Treatment	TSS			Acid			TSS/Acid		
	2023	2024	mean	2023	2024	mean	2023	2024	mean
Control	16.40 D	16.62 B	16.51 E	0.37 A	0.37 A	0.37 A	44.28 C	44.88 E	44.58 F
Ammonium Nitrate 100 ppm	16.55 CD	16.84 AB	16.69 DE	0.36 AB	0.36 AB	0.36 AB	46.09 BC	46.78 DE	46.44 E
Ammonium Nitrate 200 ppm	16.66 BCD	16.88 AB	16.77 CD	0.36 AB	0.36 AB	0.36 AB	46.21 BC	46.97 DE	46.59 E
Ammonium Nitrate 400 ppm	16.76 BC	16.88 AB	16.82 BCD	0.36 AB	0.36 AB	0.36 AB	46.57 B	46.98 DE	46.77 DE
Seaweed Extracts 1%	16.95 AB	17.1 A	17.03 AB	0.34 C	0.34 C	0.34 C	49.71 A	50.15 ABC	49.93 AB
Seaweed Extracts 2%	16.98 AB	17.12 A	17.05 AB	0.34 C	0.34 C	0.34 C	50.04 A	50.67 AB	50.35 A
Seaweed Extracts 4%	17.11 A	17.2 A	17.16 A	0.34 C	0.34 C	0.34 C	50.30 A	50.86 A	50.58 A
Mepiquat Chloride 100 ppm	16.88 ABC	16.92 AB	16.90 BCD	0.35 BC	0.35 BC	0.35 BC	48.29 AB	48.21 CD	48.25 CD
Mepiquat Chloride 200 ppm	16.85 ABC	17.00 A	16.92 ABCD	0.35 BC	0.35 BC	0.35 BC	48.23 AB	48.65 BCD	48.33 C
Mepiquat Chloride 400 ppm	16.87 ABC	17.06 A	16.96 ABC	0.35 BC	0.35 BC	0.35 BC	48.11 AB	48.55 BCD	48.44 BC

The treatments that took the same letters within column are not significantly different according to LSD at 5% level of probability.

- Reducing sugars (%)

Table (3) presented that all the treatments significantly surpassed the control. The best treatments in this respect were seaweed extract at 4%. It recorded 15.53, 15.68 and 15.10% for the 1st, 2nd and average of the two seasons, respectively.

- Anthocyanin content (mg/100g)

Table (3) showed that, during the two seasons, all the treatments significantly exceeded the control. During the 1st season, seaweed extract at 4% and 2% gave the highest value (73.00 and 71.11 mg/ 100g). During the 2nd season, seaweed extract at 4% was the best treatment (63.53 mg/ 100g). Two seasons average data took the same trend.

Table 3. Effect of ammonium nitrate, seaweed extract and mepiquat chloride on reducing sugars and anthocyanin contents of Manfalouty pomegranate cultivar during 2023 and 2024 seasons.

Treatment	Reducing sugars			Anthocyanin		
	2023	2024	mean	2023	2024	mean
Control	13.357 C	13.12 F	13.238 G	50.07 G	43.07 H	46.568 H
Ammonium Nitrate 100 ppm	13.67 BC	13.535 EF	13.60 FG	59.21 F	48.73 G	53.97 G
Ammonium Nitrate 200 ppm	13.7 BC	13.62 DEF	13.66 EFG	62.15 E	49.6 FG	55.87 F
Ammonium Nitrate 400 ppm	13.87 ABC	13.99 CDE	13.93 DEF	61.8 E	50.2 EF	56.00 EF
Seaweed Extracts 1%	14.39 AB	14.83 B	14.61 ABC	70.45B	56.33 C	63.39 B
Seaweed Extracts 2%	14.46 AB	14.97 AB	14.71 AB	71.11AB	57.6 B	64.36 B
Seaweed Extracts 4%	14.525 A	15.68 A	15.10A	73 .00A	63.53 A	68.27 A
Mepiquat Chloride 100 ppm	13.96 ABC	14.36 BCD	14.16 CDE	63.6DE	50.82DE	57.21 DE
Mepiquat Chloride 200 ppm	14.02 ABC	14.5 BC	14.26 BCD	64.67CD	51.75D	58.21 D
Mepiquat Chloride 400 ppm	14.14 ABC	14.46 BC	14.30 BCD	66.19C	55.6C	60.89C

The treatments that took the same letters within column are not significantly different according to LSD at 5% level of probability.

Discussion

The present study suggested that seaweed extract exhibited the best results for most of the studied characteristics followed by mepiquat chloride which gave also better results compared with Ammonium nitrate. These two treatments significantly exceeded the control in most of traits. Seaweed extracts are natural fertilizers containing various nutrients, amino acids and plant hormones. Seaweed extracts are used in fruit trees for enhancing growth and yield. Investigators found that the seaweed extract stimulated the vegetative growth, increased yield and improved fruit quality.

For instance, Sabry *et al*., (2009) found that it increased yield components and improved physical and chemical characteristics of Red Globe grapes.

Also, Bondok *et al.*, (2010) suggested that foliar application of seaweed extract significantly enhanced yield parameters and improved fruit quality of Flamed Seedless grapes. Strydom (2014) revealed that seaweed extract significantly increased TSS% and decreased acidity. Hussein *et al*., (2021) found that application of seaweed extract increased fruit size and weight, TSS%, total yield/ tree and number of fruits/ tree.

Other investigators found the same results, e.g. El-Sese *et al*., (2020), Gouda (2021), Arioli *et al*., (2021), Masoud *et al* (2023), Qaoud and Zagzog (2023). Abada *et al*., (2023), Mousavi *et al*., (2024) and Harhash *et al*., (2024). They agreed up on the effectiveness of S.E on fruit trees.

The present study suggested that seaweed extract has a positive effect on yield component, physical and chemical fruit characteristics. These results came online with that reported by other investigators.

Mepiquat chloride (M.C) is a growth retardant used for reducing vegetative growth. The results of current study observed that this treatment had a positive effect on yield components and fruit quality. Some investigators found that it was effective for enhancing the fruiting and yield of fruit trees. For instance, Abdel-Mohsen (2015) suggested that treated Superior grapes with Mepiquat chloride increased fruitfulness, number of clusters/ vine, berry weight and yield components. Also, Duval and Golden (2005) found that application of Mepiquat chloride increased the fruit set%. The results of current study are accordance with that mentioned by previous workers, where Mepiquat chloride significantly improved yield components and fruit quality of Manfalouty pomegranate cultivar.

On the other hand, the least effective treatment was Ammonium nitrate. According to the data of the present study, it had little effect on most of the studied characteristics.

Conclusion

The results of the current study showed that treatment with seaweed extract and Mepiquat chloride had a positive effect on yield components and fruit quality. On the other hand, the least effective treatment was Ammonium nitrate. According to the data of the present study, it had little effects on most of the studied characteristics

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تأثير كلوريد المبيكوات ونترات الأمونيوم ومستخلص الأعشاب البحرية على المحصول والخصائص الكيميائية لثمار الرمان المنفلوطي

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قسم الفاكهة، كلية زراعة، جامعة أسيوط، اسيوط، مصر.

الملخص

أجريت هذه الدراسة خلال موسمي 2023 ،2024 لدراسة تأثير نترات الأمونيوم ومستخلص الأعشاب البحرية وكلوريد المبيكوات. وكان الهدف من هذه الدراسة هو دراسة تأثير المركبات الكيميائية المختلفة: كلوريد المبيكوات ونترات الأمونيوم ومستخلص الأعشاب البحرية على المحصول وجودة ثمار صنف الرمان منفلوطي المزروع تحت ظروف أسيوط المناخية. وقد أدى استخدام مستخلص الأعشاب البحرية بمعدلات ،1- 2 -4 إلى زيادة معنوية في عدد الثمار / شجرة ووزن المحصول الكلي مقارنة بمعاملة الكنترول. وقد اشارت النتائج إلى أن مستخلص الأعشاب البحرية له تأثير إيجابي على مكونات المحصول والخصائص الكيميائية للثمار. وقد توافقت هذه النتائج مع التي توصل اليها باحثون آخرون.

الكلمات المفتاحية: *الرمان، المحصول، مستخلص الأعشاب البحرية، كلوريد المبيكوات، نترات الأمونيوم.*