EFFECT OF SPRAYING WITH FENUGREEK EXTRACT, POTASSIUM SILICATE AND SALICYLIC ACID ON YIELD AND FRUIT QUALITY OF TWO POMEGRANATE CULTIVARS UNDER RECLAIMED SOILS CONDITIONS

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This experiment was done throughout two successive seasons (2018 and 2019) on eight years old Wonderful and H116 pomegranate cultivars, atba private orchard located in Alexandria desert road, Al-Behaira Governorate, Egypt. Fifty-six pomegranate trees were chosen for this investigation, that grown in sandy soil under a drip irrigation system and spaced 3 x 5 m apart. The purpose of this study was to inspect the effect of fenugreek seed extract, salicylic acid and potassium silicate on leaf mineral content, yield and fruit quality of the pomegranate cultivars. The present investigation was laid out in a split-plot design, where the treatments placed in the main plots and the two pomegranate cultivars were allocated in subplots with four replications seven foliar application treatments used as follow: untreated tree (control treatment), fenugreek seed extract at 4 and 8 g/L, salicylic acid at 5 and 10 g/L and potassium silicate at 100 and 200 ppm spraying treatments. Treatments were applied monthly from June till the preharvest time. The obtained results revealed that, in most cases all treatments enhanced pomegranate yield characters and fruit quality compared with untreated trees. Spraying potassium silicate at 200 ppm had a beneficial role in enhancing Wonderful cultivar trees growth as well as leaves percentage of phosphorus and potassium, fruit physical properties, fruit and length, total yield, total aril weight / fruit, fruit cracking (%) and marketable fruits (%). The obtained data also showed improvement in fruit chemical properties as well as TSS (%), total sugar (%), anthocyanin and lower acidity (%) under conditions of this study.

Keywords: Wonderful, H116, pomegranate, cultivars, fenugreek seeds extract, salicylic acid, potassium silicate, yield

INTRODUCTION

Pomegranate (*Punica granatum* L.) is a fruit crop with a significant economic value, grown in tropical and subtropical regions of the world. Pomegranate fruit is considered a healthy food. It is a rich source of powerful antioxidants, vitamin E and C, carbohydrates, sugars, acids, fibers, protein and nutrients (Viuda-Martos et al., 2013 and Valero et al., 2014). Meanwhile, pomegranate is utilized in traditional medicine, which has protective effects against many diseases (Heber et al., 2006 and Bhowmik et al., 2015).

There are many foreign varieties like Wonderful and Early H116, which grown successfully in the newly reclaimed land in Egypt. Pomegranate fruit quality depends on many factors such as genetic factors, nutritional deficiency, horticulture practices and environmental conditions such as (solar radiations, high temperatures, low humidity, water imbalance), which led to fruits crack, sunburn damage and poor coloration of arils which decrease marketability (Hamouda et al., 2015 and Bakeer, 2016). Poor management practices in orchards like water and mineral deficiencies led to fruit physiological disorders like fruits cracking, sunburn damage and arils poor coloration (Yilmaz and Özgüven, 2019). The temperature in July and August can have an effect on pomegranat trees causing fruit cracking and sunburn damage to reach up to 40-65% of the total yield (Yazici and Kaynak, 2009). Growth promoters can be used to avoid negative impact on yield and fruit quality, plant extracts like fenugreek seeds extract can be used to reduce effect of heat stress on tree growth of pomegranate, yield and fruit quality (Hasan et al., 2014).

Fenugreek (*Trigonella foenum-graecum* L.), also known as fenugreek, is an annual herbaceous legume that has long been used in medicine, food, and animal feed. Fenugreek seeds are characterized as a good source of phytochemical components which have antioxidant effects and are traditionally used as folk medicine and food forage (Kaviarasan et al., 2007). Furthermore, fenugreek seed is very rich in complex substances such as steroidal saponins (trigoneoside and furostanol), flavonoids (luteolin, quercetin, and apigenin), and fixed oils (lipids). It contains many chemical compounds, carbohydrates (galactomannans and mucilaginous fiber), proteins (lysine and tryptophan), pyridine-type alkaloids, (trigonelline), higher amounts of volatile oils, phenolics (coumarin: scopoletin), and steroidal sapogenins (fenugreekine). Also, is a good source of minerals like Ca, P, K, Mg, and Fe, as well as vitamins like A, B, B2, B6, and C, these elements are protecting the trees (Belguith-Hadriche et al., 2013). Recent research has focused on the potential application of plant extracts for enhancing plant for improving plant growth, yield, nutrient uptake, resistance to stress conditions (Yakhin et al., 2017).

Al-Hameedawi and Al-Shemmeryi (2018) showed that foliar spray with fenugreek seed extracts increased growth, yield and fruit quality as well

as total soluble solids (TSS), acidity, vitamin C and antioxidant of fruits after 3 months from storage of Sours orange trees pre and post storage. Natural bio stimulants supplying the plants with their requirements from mineral, natural hormones, antioxidants and organic foods surely reflected on enhancing tree nutritional status, protecting the trees from unfavorable conditions and enhancing cell division and biosynthesis of carbohydrates and plant pigments promoting yield and fruit characteristics (Anwar et al., 2013 and El-Sayed, 2014). El-Sayed and Abd El All (2022) stated that spraying with natural fenugreek seeds extract as an anti-transpiration natural material is a good tool to increase Egyptian cotton growth, productivity, and quality successfully under lack of water in the soil and high air temperature. On the other hand, foliar application of macro and micro-nutrients corrects their deficiency and reduces cracked fruit percentage, as well as improvs tree yield and fruit quality of pomegranate trees (Khalil and Aly 2013 and Hamouda et al., 2015). Natural substances like salicylic acid (SA) produced in plant in low quantities to help the plant growth and tolerance against biotic and abiotic stresses (War et al., 2012). Also applying these substances improves plant functions (Abd El-all and Fouad, 2019).

SA is known as a defense hormone, it is a phenolic compound as a potential nonenzymatic antioxidant that participates in the organizing controller for many metabolites physiological activities in plants, such as transpiration, ion absorption, stomata closure, photosynthesis, suppression of ethylene biosynthesis, and stress tolerance (Khan et al., 2003 and Simaei et al., 2012), It is a key element in plant resistance to pathogens, SA has important roles in the synthesis of chloroplasts of plant processes. Furthermore, SA has a transcriptome adaptation mechanism in response to abiotic stress and activates particular molecular processes and stimulates the synthesis of protective components such as polyamines (Ding et al., 2020). The positive action of SA could be effective on several processes in plants such as cell elongation, cell division, cell differentiation, sink/source regulation, plant pigments, enzymatic activities, protein synthesis and photosynthetic activity as well as increases the antioxidant capacity of plants (Fayed, 2010 and Tahira et al 2013).

Potassium silicate is a source of highly soluble K and silicon and is crucial to agricultural production systems (Kanai et al., 2007). Potassium (K) is considered a component of macronutrients and its concentration in peel and aril of pomegranate fruits is the highest compared to macronutrients (Mirdehghan and Rahemi, 2007). Also, K is called the “quality element”. The importance of quality can be encouraging photosynthetic synthesis, which is then transported to fruits and storage organs where it is converted into carbohydrates, protein, vitamins, and other substances (Mengel and Kirkby, 1987). In addition, it is important for physiological functions of K, such as the formation of sugars, starch, the synthesis of proteins, enzyme activation, cell division, stomatal function photosynthesis, fruit formation develops fruit

quality by enhancing fruit size, flavour and color (Tiwari, 2005 and Ashraf et al., 2013).

Moreover, silicon increased resistance mechanisms to abiotic and biotic stresses in plants by preserving the water balance and photosynthetic activity of plants and enhances resistance to diseases (Sakr, 2016), as well as utilizes alleviative impacts on several abiotic stress tolerance which include drought and salt stress, water logging, nutrient imbalance, radiation damage and high temperature (Kim et al., 2014 and Coskun et al., 2016). In plants, silicon promotes growth, photosynthesis, leaf hardness, leaf chlorophyll content, and product quality while reduces transpiration and evaporation (Richmond and Sussman, 2003). Furthermore, in many horticultural crops, it is in charge of promoting water transport, cell division, and root development under adverse circumstances. It also raises antioxidant activity and lowers oxidative damage.

Potassium silicon treatments at 3 and 4.5% K-Si improves the weight of peach fruits, colour, firmness, TSS, titratable acidity, fruit composition, fruit weight loss. Also, anthocyanins and total phenolics increase after cold storage period under K-Si treatments (Abidi et al., 2023).

This investigation aimed to study the impact of spraying fenugreek seeds extract, SA, potassium silicate on growth, leaf mineral content, tree yield and the fruit quality such as sunburn fruits, fruit cracking and fruit marketable of pomegranate cultivars Wonderful and H116.

MATERIALS AND METHODS

1. Field Experiment

This experiment was done at a private orchard situated in Cairo-Alexandria desert, 107 km from Cairo-Alexandria Road, Governorate of Al-Behaira, Egypt. Throughout the two seasons of 2018 and 2019 on eight years old trees of Wonderful and H116 pomegranate cultivars spaced 3 x 5 meter apart, grown beneath a drip irrigation system in sandy soil. Fifty-six of pomegranate trees were almost uniform in shape and received the standard agricultural practices that were used in the orchard inclusive fertilization, irrigation and pest management.

2. Experimental Design

This study consisted of two factors, the first had seven levels of foliar spray application: Control (untreated), fenugreek seed extract at 4 g/L, fenugreek seed extract at 8 g/L, SA at 5 g /L, SA at 10 g /L, potassium silicate at 100 ppm and potassium silicate at 200 ppm. The second factor was the two pomegranate cultivars Wonderful and H116. The study was set up in a split-plot design where the foliar spray treatments were placed in the main plots and the two cultivars were placed in the sub plots. Thus, the experiment consisted of fourteen experimental units with four replicates, one tree for each replicate.

3. Rates and Applying Methods of Fenugreek Extract, Salicylic Acid and Potassium Silicate

The experiment consisted of twenty-eight trees for each cultivar, they were subjected to seven treatments as: Control (untreated), fenugreek seed extract as foliar sprays at a rate of 4 and 8 g/L, SA at 5 and 10 g/L and potassium silicate at 100 and 200 ppm. Tween-20 was added as a surfactant at 0.1% to the spray solution, which included "tap water" as the control. Every treatment was sprayed once a month beginning in June until harvest time (September). Fenugreek extract was homogenized with distilled water at 1: 10 using an electric blender for five minutes, filtered, and refrigerated at 4°C until use. **Preparation of SA solution:** Solutions of SA were modified to pH 6.0 using NaOH followed by solubilized in a few drops of ethyl alcohol. **Preparation of silicon solution:** It was prepared as suggested by Alexand et al. (1954) by dissolving 0.1 or 0.2 g of SiO_2 in 100 ml of KOH for 24 h, then diluted to 1 liter. As shown by Rahal et al. (2023), fenugreek seeds extract has the following composition in Table (1).

Table (1). Chemical composition of 100 g fenugreek seed.

Component	Content (per 100 g)	Component	Content (per 100 g)
Humidity	7.49 g	Nicotinic acid	1.1 mg
Carbohydrates	42.3 g	Beta carotene	96 µg
Proteins	25.4 g	Thiamine	340 µg
Lipids	7.9 g	Riboflavin	290 µg
Fibers	50 g	Folic acid	94 µg
Ashes	3.38 (g)	Potassium (K)	603 mg
Vitamin A	60-100 IU	Magnesium (Mg)	42 mg
Vitamin C	12-43 mg	Calcium (Ca)	75 mg
Vitamin B1	0.41 mg	Manganese (Mn)	0.9 mg
Vitamin B2	0.36 mg	Copper (Cu)	0.9 mg
Vitamin B6	0.6 mg	Zinc (Zn)	2.4 mg
Niacin	6 mg	Iron (Fe)	25.8 mg

4. Leaf Chlorophyll and N, P, K contents

4.1. Leaf chlorophyll content

Using a chlorophyll meter (SPAD-502; Konica Minolta, Osaka, Japan), the amount of chlorophyll in fresh leaves was measured. The results were expressed in SPAD units.

4.2. N, P and K contents in leaf

Percentages of N, P, and K in leaves from spring growth cycle non-fruiting shoots were recorded. The middle leaves of the terminal sprouting shoots were used to collect samples in the last week of September, which were then repeatedly cleaned with tap water, distilled water, and dried at 70°C in an

electric oven until they reached a constant weight. Dry leaves were crushed and broken down in accordance with Jackson (1973). Mineral content of leaves N, P and K were determined in accordance with Cottenie et al. (1982).

5. Yield and its components

Five fruits per tree were sampled at random to ascertain the following chemical and physical characteristics for every season.

5.2.1. Fruit physical properties

Pomegranate trees of both cultivars were picked up at maturity stage "first week of October" to determine the average fruits weight. Ten fruits were taken from each tree to determine the yield as a number and weight of fruits. Calculating the yield per tree in kg was done by multiplying average fruits weight by the number of fruits per tree.

Fruit weight (g), peel thickness (cm), fruit length (cm) and fruit diameter (cm) were measured by a caliper. Weight of 100 arils (g), number of arils/fruit, total arils weight/fruit (g) were also recorded. Fruit juice (%), sunburn (%), fruit cracking (%) and marketable fruits (%) were calculated using the following equations:

$$\text{Fruit juice (\%)} = \frac{\text{juice weight}}{\text{fruit weight}} X\ 100$$

$$\text{Sunburn (\%)} = \frac{\text{number of sunburned fruits per tree}}{\text{total number of fruits pre tree}} X\ 100$$

$$\text{Fruit cracking (\%)} = \frac{\text{number of cracked fruits per tree}}{\text{total number of fruits pre tree}} X\ 100$$

$$\text{Marketable fruits \%} = \frac{\text{Total number of fruits per tree} - (\text{sunburned fruit number} + \text{fruit cracking number})}{Total\ number\ of\ fruits\ per\ tree} X\ 100$$

5.2.2. Fruit chemical properties

Total soluble solids (TSS) were estimated using the hand refractometer. By titrating NaOH at 0.1 N in line with A.O.A.C. (2000), total acidity was determined. Total sugars percentage were determined as outlined in A.O.A.C. (2000). Total anthocyanin concentration was determined using HCl (1.5 N) by a spectrophotometer as described in A.O.A.C. (1990).

6. Statistical Analysis

The data acquired were subjected to proper statistical analysis of variance for a split plot design (two factors), each treatment had four replicates, each of which was represented by a single tree. All obtained data during the two seasons of 2018 and 2019 were subjected to analysis of different alphabetical letters in the column that significantly differed at 0.05 level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

1. Leaf Chlorophyll and N, P, K Contents

1.1. Leaf total chlorophyll

In relation to the amount of chlorophyll in the leaves, it is noticed from Table (2) that, there were significant differences between the treatments since the higher value was obtained with 8 g/L fenugreek extract in both studied seasons (70.22 and 70.08, respectively) compared with the other treatments. On the other hand, there were significant differences between the two cultivars, Wonderful cultivar gave the highest value for the two seasons (62.81 and 62.77, respectively) compared with pomegranate H116 cultivar. Regarding the interaction, the highest values for the leaves' total chlorophyll content were obtained with 8 g/L fenugreek extract for the two pomegranate cultivars (70.40, 69.88 and 70.04, 70.27) H116 and wonderful in the two seasons, respectively. However, the lowest values were gained by the control (53.90, 52.48 and 54.82, 53.39) in the two seasons, respectively.

1.2. Leaf nitrogen content

Results in Table (2) show that N, P, and K in leaves were considerably different among all sprayed treatments and the two pomegranate cultivars in both seasons. The highest significant leaf N content was gained by 200 ppm potassium silicate (2.03 and 2.02%) in the two seasons, respectively. On the contrary, the lowest values were obtained from the control (1.59 and 1.6%, respectively). In addition, significant improvement in leaf N content was recorded (2.01 and 1.99%) in H116 cultivar in both seasons. For the interaction, data showed that 8 g/L fenugreek extract during the two studied seasons gave the highest significant leaf N content (2.28 and 2.25%) with H116 cultivar in both seasons. While the lowest values were obtained with the control (1.52 and 1.54%, respectively).

1.3. Leaf phosphorus content

Data in Table (2) show that the highest significant leaf P % was recorded by potassium silicate at 200 ppm (0.20 and 0.19%) while, the control gave 0.12 and 0.11% in both seasons, respectively. On the other hand, Wonderful cultivar produced higher significant P % (0.18 and 0.18%) than H116 pomegranate cultivar in both seasons (0.14 and 0.14%), respectively. Regarding interaction, the treatment of 200 ppm potassium silicate gave the highest significant P content (0.22 and 0.22%) with Wonderful pomegranate cultivar in both seasons, respectively. On the contrary, the lowest values were gained by control in the two seasons.

1.4. Leaf potassium content

Regarding leaf K content, potassium silicate at 200 ppm produced the highest significant leaf K content (1.11 and 1.11%), while the control (untreated trees) had the lowest significant K content (0.90 and 0.91%) in both seasons, respectively. Where, insignificant differences were shown between H116 and Wonderful pomegranate cultivars in both seasons. For the

Table (2). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on leaf chlorophyll and leaf N, P, K contents of pomegranate Wonderful and H16 cultivars during 2018 and 2019 seasons.

Treatments	Chlorophyll SPAD values			Leaf N %			Leaf P %			Leaf K %		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
					Season 2018							
Control (untreated)	53.90e	54.82de	54.36E	1.66f	1.52g	1.59D	0.12fgh	0.11h	0.12E	0.91ef	0.89f	0.90D
Fenugreek extract at 4 g/L	60.53bc	63.00b	61.76C	1.82cd	1.65f	1.73C	0.15de	0.14ef	0.15D	0.97de	0.99bcd	0.98C
Fenugreek extract at 8 g/L	70.40a	70.04a	70.22A	2.28a	1.71ef	1.99AB	0.12gh	0.17cd	0.14D	0.99d	1.01bcd	1.00C
Salicylic acid at 5 g/L	62.54b	67.75a	65.15B	1.81cd	1.75de	1.79C	0.13fg	0.19b	0.16C	0.92ef	0.92ef	0.92D
Salicylic acid at 10 g/L	61.55bc	61.70bc	61.62C	2.17b	1.78cde	1.98AB	0.13fg	0.22a	0.18B	1.05bc	1.05b	0.11B
Potassium silicate at 100 ppm	52.82de	59.33bcd	57.08DE	2.12b	1.81cd	1.97B	0.17cd	0.22a	0.18B	0.99cd	0.98d	0.99C
Potassium silicate at 200 ppm	56.75cde	63.02b	59.89CD	2.19b	1.86c	2.03A	0.18bc	0.22a	0.20A	1.11a	1.11a	1.11A
Mean	60.07B	62.81A		2.01A	1.73B		0.14B	0.18A		0.99A	0.99A	
					Season 2019							
Control (untreated)	52.48e	53.39de	52.94d	1.67h	1.54i	1.60D	0.11f	0.12def	0.11C	0.91ef	0.90f	0.91D
Fenugreek extract at 4 g/L	59.40c	63. 59bc	61.20B	1.82de	1.68h	1.75C	0.16b-f	0.14c-f	0.15BC	0.99cde	0.94def	0.97C
Fenugreek extract at 8 g/L	69.88a	70.27a	70.08A	2.25a	1.71gh	1.98AB	0.12def	0.17a-e	0.15BC	1.07abc	1.04abc	1.06AB
Salicylic acid at 5 g/L	61.73c	67.39ab	64.56B	1.80e	1.74fg	1.77C	0.12def	0.19abc	0.15BC	0.99cd	0.93def	0.96C
Salicylic acid at 10 g/L	61.77c	62.07bc	61.92B	2.13bc	1.77ef	1.95B	0.11ef	0.21ab	0.16B	1.03bc	1.06abc	1.04B
Potassium silicate at 100 ppm	53.47de	59.68c	56.58C	2.10c	1.82de	1.96B	0.16b-f	0.20abc	0.18AB	1.06abc	1.05abc	1.05AB
Potassium silicate at 200 ppm	58.04cd	63.61bc	60.83B	2.17b	1.86d	2.02A	0.17a-d	0.22a	0.19A	1.11a	1.10ab	1.11A
Mean	59.54B	62.77A		1.99A	1.73B		0.14B	0.18A		1.02A	1.00A	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

interaction, the observed data revealed that the highest significant leaf K % was shown with potassium silicate at 200 ppm (1.11, 1.11 and 1.11, 1.10%) with H116 and Wonderful pomegranate cultivars in both seasons, respectively.

2. Yield and its components

2.1. Fruit physical properties

The effect of spraying with fenugreek extract, salicylic acid and potassium silicate on tree yield and fruit physical properties of the two pomegranate cultivars are represented in Table (3, 4, 5 and 6).

2.1.1. Number of fruits/tree

Result in Table (3) show that, the highest value of fruits number per tree was observed by using potassium silicate at 100 ppm (65.33 and 64.83) and potassium silicate at 200 ppm (65.33 and 65.83) in the first and second seasons, respectively. While untreated trees gave 48.50 and 51.17 in the two seasons, respectively. Regarding cultivars, data revealed that, H116 pomegranate cultivar had the higher fruits number /tree (63.76 and 66.14) in the two seasons, respectively. Moreover, results illustrate that H116 pomegranate trees sprayed with potassium silicate at 100 ppm gained the highest values (71.67 and 71.67) in the first and second seasons, respectively. The lowest values were recorded by untreated trees in both cultivars in the first and second seasons (52.0, 45.0 and 53.33, 49.00), respectively.

2.1.2. Total yield/tree

Concerning the data of yield per tree (kg) in Table (3), spraying trees with potassium silicate at 200 ppm in both seasons gave the highest yield/ tree (20.90 and 22.05, respectively). The lowest values (12.51and 12.57) were recorded by control in the two seasons, respectively. On the contrary, there were insignificant differences between H116 and Wonderful pomegranate cultivars in the two seasons. For the interaction, results indicate that Wonderful pomegranate trees treated with potassium silicate at 100 ppm gave the highest yield/ tree (23.32 and 25.18) in both seasons, respectively. The lowest values were recorded by control in both seasons (12.82 and 12.65, respectively).

2.1.3. Peel thickness

Concerning the results in Table (3), insignificant differences among treatments could be noticed. Regarding cultivars, Wonderful cultivar had lower values than H116 cultivar. The interaction between treatments and cultivars revealed that Wonderful pomegranate trees treated with fenugreek

Table (3). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on number fruits/tree, yield tree and peel thickness (cm) of Wonderful and H16 pomegranate cultivars during 2018 and 2019 seasons.

Treatments	No. of fruits per tree			Yield per tree (kg)			Peel thickness (cm)		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
				Season 2018					
Control (untreated)	52.00f	45.00g	48.50D	12.82fg	12.20g	12.51C	0.27ab	0.30ab	0.25 A
Fenugreek extract at 4 g/L	71.67a	56.00def	63.83AB	22.67ab	16.47def	19.57AB	0.26b	0.24b	0.26A
Fenugreek extract at 8 g/L	65.33b	53.67ef	59.50C	20.33a-d	15.67efg	18.00B	0.34ab	0.22b	0.28A
Salicylic acid at 5 g/L	65.67b	57.67cde	61.67ABC	18.96b-e	19.40a-e	19.18AB	0.27ab	0.22b	0.25A
Salicylic acid at 10 g/L	58.00cde	65.00b	61.50ABC	17.34cde	20.75abc	19.04AB	0.41a	0.24b	0.33A
Potassium silicate at 100 ppm	71.67a	59.00cde	65.33A	21.97ab	21.04abc	21.50A	0.25b	0.28ab	0.28A
Potassium silicate at 200 ppm	62.00bc	60.33bcd	65.33A	18.48b-e	23.32a	20.90A	0.33ab	0.23b	0.31A
Mean	63.76A	56.67B		18.94A	18.41A		0.31A	0.25B	
				Season 2019					
Control (untreated)	53.33fg	49.00g	51.17C	12.65e	12.49e	12.57D	0.33ab	0.24b	0.25A
Fenugreek extract at 4 g/L	71.33ab	57.33def	64.33AB	21.32b	16.44cde	18.88BC	0.27b	0.23b	0.26A
Fenugreek extract at 8 g/L	63.33b-e	55.33efg	59.33B	18.71bcd	15.98de	17.34C	0.27b	0.23b	0.28A
Salicylic acid at 5 g/L	65.67a-d	59.33efg	62.50AB	19.33bcd	19.26bcd	19.29ABC	0.28b	0.27b	0.26A
Salicylic acid at 10 g/L	59.33c-f	61.00c-f	60.17AB	17.20bcd	19.17bcd	18.18BC	0.40a	0.29ab	0.34A
Potassium silicate at 100 ppm	71.67a	58.00def	64.83AB	20.87b	20.71bc	20.79AB	0.26b	0.24b	0.28A
Potassium silicate at 200 ppm	64.33a-d	67.33abc	65.83A	18.92bcd	25.18a	22.05A	0.33ab	0.26b	0.30A
Mean	66.14A	58.19B		18.43A	18.46A		0.31A	0.24b	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

extract at 4 g/L recorded the lowest peel thickness (0.22 and 0.23 cm) in the two seasons, respectively.

2.1.4. Fruit weight

Results in Table (4) show that there were insignificant differences between treatments concerning fruit weight in the first season while the lowest fruit weight was recorded by the control (254.2 g). In the second season, the highest fruit weight was obtained with 200 ppm potassium silicate (334.0 g) as compared with the untreated trees which gained the lowest value (253.5 g). Moreover, the results indicated that Wonderful pomegranate cultivar had significantly higher fruit weight (318.5 and 317.7 g) in the first and second seasons, respectively comparing with H116 pomegranate cultivar (287.6 and 282.1 g) in both seasons, respectively. For the interaction, data revealed that Wonderful pomegranate trees treated with potassium silicate at 200 ppm achieved the highest fruit weight (381.8 and 376.7 g) in both seasons, respectively. While untreated trees gained the lowest values in the first and second seasons.

2.1.5. Fruit length

Data revealed that potassium silicate at100 ppm gained the highest fruit length (7.89 and 7.85 cm) in both seasons, respectively. Control had the lowest values (6.80 and 6.74 cm) in both seasons, respectively. Regarding cultivars H116 and Wonderful pomegranate data, it is shown that Wonderful had higher fruit length (7.58 and 7.57 cm, respectively) during the first and second seasons of study as compared with H116 pomegranate cultivar. Regarding interaction, data illustrated that, Wonderful pomegranate cultivar trees treated with potassium silicate at 100 ppm gave higher fruit length (8.60 and 8.54 cm) in both seasons, respectively. As compared with the control, H116 cultivar trees gained lower values (6.40 and 6.27 cm respectively) during both seasons of study.

2.1.6. Fruit diameter

Regarding the results in Table (4), the highest fruit diameter was obtained by 200 ppm potassium silicate (8.34 and 8.50 cm, respectively) in both seasons. On the contrary, the lowest fruit diameter was obtained with the control treatment (7.63 and 7.55 cm) in both seasons, respectively. Regarding cultivars, there were insignificant differences between pomegranate cultivars. For interaction data it is obvious that the highest values were gained by potassium silicate at 200 ppm with Wonderful cultivar (8.73 and 9.05 cm) in the two seasons, respectively.

2.1.7. Weight of 100 arils

The results for weight of 100 arils are displayed in Table (5). the highest values were recorded by 4 g/L fenugreek extract (44.80 g) in the first season, whereas the second season insignificantly affected the weight of 100 arils. With respect to pomegranate cultivars, data illustrated that H116 pomegranate trees gave the highest weight of 100 arils (42.87 g) in the first season only. Whereas in the second season there were insignificant values

Table (4). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on fruit weight (g), fruit length (cm) and fruit diameter of Wonderful and H116 pomegranate cultivars during 2018 and 2019 seasons.

Treatments	Fruit weight (g)			Fruit length (cm)			Fruit diameter (cm)		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
Season 2018									
Control (untreated)	239.0d	269.4cd	254.2B	6.40c	7.19bc	6.80C	7.74bc	7.51c	7.63C
Fenugreek extract at 4 g/L	305.2bc	287.2cd	296.2A	7.51b	7.23bc	7.37ABC	8.36ab	7.99bc	8.18AB
Fenugreek extract at 8 g/L	310.0bc	286.9cd	298.4A	7.13bc	7.27bc	7.20BC	7.83bc	8.28ab	8.05ABC
Salicylic acid at 5 g/L	285.5cd	328.5abc	307.0A	7.24bc	7.33bc	7.28ABC	7.78bc	7.89bc	7.83BC
Salicylic acid at 10 g/L	291.1cd	310.0bc	300.6A	7.63b	7.51b	7.57AB	8.06abc	8.19abc	8.12ABC
Potassium silicate at 100 ppm	289.9cd	365.4ab	327.6A	7.19bc	8.60a	7.89A	7.98bc	8.02abc	8.00ABC
Potassium silicate at 200 ppm	292.2cd	381.8a	337.0A	6.97bc	7.92ab	7.44ABC	7.95bc	8.73a	8.34A
Mean	287.6B	318.5A		7.15B	7.58A		7.96A	8.09A	
Season 2019									
Control (untreated)	238.6d	268.4cd	253.5C	6.27c	7.20bc	6.74B	7.61bc	7.49c	7.55C
Fenugreek extract at 4 g/L	289.6cd	284.9cd	287.3BC	7.47b	7.22bc	7.34AB	8.39ab	8.07bc	8.23AB
Fenugreek extract at 8 g/L	295.0cd	287.9cd	291.4ABC	7.20bc	7.28bc	7.24AB	7.89bc	8.21bc	8.05ABC
Salicylic acid at 5 g/L	285.1cd	328.1abc	306.6AB	7.31bc	7.30bc	7.31AB	7.80bc	7.86bc	7.83BC
Salicylic acid at 10 g/L	288.7cd	310.2bc	299.4AB	7.61ab	7.47b	7.54A	8.08bc	8.17bc	8.12AB
Potassium silicate at 100 ppm	286.3cd	367.5ab	326.9AB	7.17bc	8.54a	7.85A	7.97bc	8.00bc	7.98ABC
Potassium silicate at 200 ppm	291.2cd	376.7a	334.0A	6.95bc	7.98a	7.46A	7.95bc	9.05a	8.50A
Mean	282.1B	317.7A		7.14B	7.57A		7.96A	8.12A	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

shown in both cultivars. As for the interaction between cultivars and treatments, H116 pomegranate cultivar when was sprayed with 4 g/L fenugreek extract gained the highest value in the first season followed by 200 ppm potassium silicate treatments (46.78, 45.20 and 43.89 g) in both seasons, respectively. On the contrary, the lowest values were recorded by untreated trees in both seasons.

2.1.8. Number of arils / fruit

The effect of spraying with fenugreek extract, SA and potassium silicate on the weight of 100 arils (g), number of arils / fruit and total aril weight / fruit (g) of pomegranate cultivars during 2018 and 2019 seasons are shown in Table (5). Concerning foliar application treatment, data cleared that, treatment of 4 g/L fenugreek extract and 5 g/L SA exhibited the highest number of arils / fruit (427.2, 424.3 and 426.7, 428.3, respectively) in both seasons, followed by 100 ppm potassium silicate in the second season only (429.2). On the other hand, untreated trees showed the lowest values in the two seasons (335.5 and 331.7, respectively). For cultivars, the differences between them lacked significance. Regarding the interaction, treatment of 4 g/L fenugreek extract with H116 gained the greatest significant values (454.3 and 456.7, respectively) in both seasons. On the other side, control proved to gain the lowest values (311 and 305, respectively) in both seasons.

2.1.9. Total aril weight / fruit

Table (5) reveals that the highest records of total aril weight / fruit were obtained by 200 ppm potassium silicate in the first season or SA at 10 g/L and 100 ppm potassium silicate in the second season only (205.6, 188.4 and 187.3 g, respectively). Meanwhile, when comparing between cultivars under study, there was an insignificant effect on total aril weight / fruit. With regard to the interaction, Wonderful pomegranate cultivar got the highest total aril weight / fruit with 200 ppm potassium silicate in the first season (239.6 g), however H116 pomegranate trees sprayed with SA at 10 g/L gave the highest value (199.6 g) in the second season.

2.1.10. Percentages of fruit juice

Data in Table (6) reveal that the highest percentages of fruit juice were obtained by 200 ppm potassium silicate (47.40 and 48.00%, respectively) in both seasons of the study. Whereas the lowest juice percentage was gained by the control (39.67 and 39.83%, respectively) in both seasons. Wonderful cultivar had higher percentages of fruit juice in both seasons (46.00 and 46.24%, respectively) compared with H116 cultivar.

Regarding the interaction effect of cultivars and treatments, Wonderful cultivar recorded the highest percentages of fruit juice with 4 g/L extract fenugreek in both seasons (51.67 and 52.33%, respectively), on the contrary, the lowest percentage was gained from the control with H116 cultivar (37.00 and 37.33%, respectively) in the first and second season.

Table (5). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on weight of 100 arils (g), number of arils / fruit and total aril weight / fruit (g) of Wonderful and H116 pomegranate cultivars during 2018 and 2019 seasons.

Treatments	Weight of 100 arils (g)			No. of arils / fruit			Total aril weight / fruit (g)		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
				Season 2018					
Control (untreated)	42.00abc	37.33cd	39.66CD	311.0d	360.0cd	335.5C	148.3d	151.5cd	149.9D
Fenugreek extract at 4 g/L	46.78a	42.83abc	44.80A	454.3a	400.0abc	427.2A	168.0bcd	167.2bcd	167.6CD
Fenugreek extract at 8 g/L	44.89ab	39.05bcd	41.97ABC	366.0bcd	365.3bcd	365.7BC	181.5bcd	153.7cd	175.7BCD
Salicylic acid at 5 g/L	44.70ab	43.17abc	43.93AB	400.7abc	452.7ab	426.7A	190.1bc	206.8ab	198.4AB
Salicylic acid at 10 g/L	42.89abc	37.11cd	40.00BCD	396.7abc	379.3a-d	388.0ABC	197.7b	180.2bcd	180.9ABC
Potassium silicate at 100 ppm	33.66d	40.89abc	43.04ABC	444.3abc	400.3abc	422.3AB	186.3bcd	197.7b	192.0ABC
Potassium silicate at 200 ppm	45.20a	40.67abc	37.17D	385.0a-d	403.0abc	394.0AB	171.5bcd	239.6a	205.6A
Mean	42.87A	40.15B		394.0A	394.4A		177.6A	185.2A	
				Season 2019					
Control (untreated)	39.93ab	40.04ab	39.99A	305.0d	358.3cd	331.7C	139.5c	168.4abc	157.0B
Fenugreek extract at 4 g/L	41.43ab	43.94a	42.69A	456.7a	398.7abc	424.3A	169.3abc	180.9ab	175.1AB
Fenugreek extract at 8 g/L	42.35ab	41.76ab	42.06A	365.0bcd	365.0bcd	365.0BC	175.5abc	162.5abc	169.0AB
Salicylic acid at 5 g/L	40.24ab	42.71ab	41.48A	403.3abc	453.3ab	428.3A	158.2bc	173.9abc	173.2AB
Salicylic acid at 10 g/L	41.00ab	36.48b	38.74A	403.3abc	381.0a-d	389.7AB	199.6a	177.2abc	188.4A
Potassium silicate at 100 ppm	42.66ab	40.98ab	41.82A	450.0ab	401.7abc	429.2A	187.7ab	186.8ab	187.3A
Potassium silicate at 200 ppm	43.89a	41.07ab	42.48A	386.7a-d	406.7abc	396.7AB	186.2ab	173.9abc	180.1AB
Mean	41.64A	41.00A		395.0A	395.0A		173.7A	176.9A	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

2.1.11. Percentage of fruit sunburn

Results in Table (6) reveal that the spraying treatments highly affected pomegranate cultivars in the two seasons. The untreated trees had the highest percentage of fruits sunburnt (%). Meanwhile the lowest percentages were recorded by 200 ppm potassium silicate treatment (11.15 and 10.45%, respectively) in the first and second seasons. As for cultivars, H116 pomegranate cultivar produced lower percentages of fruit sunburn (10.86 and 10.52%), compared with Wonderful pomegranate cultivar (17.25 and 16.60%) respectively, in the two seasons. As for the interaction effect of cultivars and treatments, H116 pomegranate cultivar treated with 4 g/L fenugreek extract showed the minimum percentage of sunburn (5.95 and 5.82%) in the first nd second season, respectively.

2.1.12. Percentage of cracking

Table (6) shows that the treatments had a substantial impact on the pomegranate fruit cracking. The highest percentage of cracking was recorded in control (untreated) treatment (13.62 and 14.94%) in both seasons, respectively. The results showed an insignificant effect between the two cultivars on percentage of cracking in the two seasons. Regarding to the interaction, the lowest values were observed in H116 pomegranate resulted by 200 ppm potassium silicate, followed by100 ppm potassium silicate (4.94 and 5.45%, respectively) in the first season, while in the second one it was only 4.380%, gained by 200 ppm potassium silicate.

2.1.13. Percentage of marketable fruits

One can noticed from the results in Table (6) that percentage of marketable fruits regarding the treatment of 200 ppm potassium silicate in two seasons, gave the highest percentage of marketable fruits (87.44 and 86.14%, respectively) compared to the control (66.65 and 64.91%, respectively). Concerning cultivars, H116 pomegranate cultivar gave higher percentages of marketable fruits (79.05 and 77.48%, respectively) compared to Wonderful cultivar in the two seasons. Regarding the interaction, H116 pomegranate cultivar sprayed by fenugreek extract at 4 g/L exhibited the highest values (87.30 and 84.95%) in two seasons compared to the control (64.86 and 64.71%), respectively.

2.2. Fruit chemical properties

2.2.1. Total soluble solids

Data presented in Table (7) reveal that the significantly highest TSS in the fruit juice was observed with SA at 10 g/L (17.64 and 17.76%) in the first and second seasons, respectively. Results also show that, the lowest TSS percentages (16.63 and 15.34%) were observed on the untreated trees during both seasons, respectively. For pomegranate cultivars, higher values of TSS % were recorded by H116 cultivar (16.79 and 16.73%, respectively) in both seasons. Regarding the interaction, H116 cultivar sprayed with SA at 10 g/L gave the highest percentages of TSS (18.09 and 18.35%) in the two seasons,

Table (6). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on fruit sunburn (%), fruit racking (%) and marketable fruits (%) of Wonderful and H116 pomegranate cultivars during 2018 and 2019 seasons.

Treatments	Fruit juice (%)			Fruit sunburn (%)			Fruit cracking (%)			Marketable fruits (%)		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
Season 2018												
Control (untreated)	37.00de	41.67b-e	39.67BC	14.58bcd	21.97a	18.28A	19.53a	7.710cde	13.62A	64.86e	68.43de	66.65C
Fenugreek extract at 4 g/L	37.67cde	51.67a	44.33AB	5.95f	21.84a	13.90BC	6.607de	9.423b-e	8.015CD	87.44a	68.73de	78.08B
Fenugreek extract at 8 g/L	32.67e	43.00a-d	37.83C	13.64cd	13.02cd	13.33BC	8.623b-e	13.02bc	10.82ABC	74.23bcd	76.01bcd	75.12B
Salicylic acid at 5 g/L	40.33b-e	44.67a-d	42.50ABC	12.06de	17.56abc	14.81B	13.34b	11.30bcd	12.32AB	75.18bcd	71.86cde	73.52B
Salicylic acid at 10 g/L	48.67ab	46.00a-d	47.33A	11.79de	13.66cd	12.73BC	10.05b-e	14.11b	12.08AB	78.15bc	72.53cde	75.34B
Potassium silicate at 100 ppm	42.33a-d	47.67ab	45.00AB	9.963def	18.44ab	14.20BC	5.45e	12.03bcd	8.743BCD	86.43a	64.49e	75.46B
Potassium silicate at 200 ppm	47.47ab	47.33abc	47.40A	8.027ef	14.28bcd	11.15C	4.94e	5.713e	5.327D	87.03a	81.87ab	84.45A
Mean	40.88B	46.00A		10.86B	17.25A		9. 80A	10.47A		79.05A	71.99B	
Season 2019												
Control (untreated)	37.33cd	42.33a-d	39.83BC	13.87cd	20.89ab	17.38A	19.12a	10.77bc	14.94A	64.71gh	65.12fgh	64.91C
Fenugreek extract at 4 g/L	41.33a-d	52.33a	46.83AB	5.82f	21.29a	13.56B	6.40def	9.193cde	7.795D	86.14a	67.42e-h	76.78B
Fenugreek extract at 8 g/L	32.33d	43.00a-d	37.67C	13.10cd	13.17cd	13.14BC	8.99cde	12.26bc	10.62BC	72.42def	75.32cd	73.87B
Salicylic acid at 5 g/L	40.67bcd	44.67abc	44.33ABC	11.78de	17.16bc	14.47B	13.10bc	11.07bc	12.09B	74.26cde	70.99d-h	72.62B
Salicylic acid at 10 g/L	48.33abc	46.33abc	47.33AB	11.76de	13.50cd	12.63BC	10.10bcd	13.71b	11.90B	76.39bcd	71.76d-g	74.07B
Potassium silicate at 100 ppm	43.00a-d	48.00abc	43.83ABC	9.583def	17.03bc	13.31BC	5.270ef	11.20bc	8.24CD	83.48ab	64.01h	73.75B
Potassium silicate at 200 ppm	49.00ab	47.00abc	48.00A	7.720ef	13.19cd	10.45C	4.380f	5.767ef	5.073E	84.95a	81.23abc	83.09A
Mean	41.71B	46.24A		10.52B	16.60A		9.62A	10.57A		77.48A	70.83B	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

respectively, compared with the untreated trees that had the lowest values (15.73 and15.05%) in the two seasons, respectively.

2.2.2. Total acidity percentage

Table (7) indicates that total acidity (%) was significantly decreased by spraying of 200 ppm potassium silicate (1.27 and 1.26%, respectively) in the two seasons. Meanwhile, the control treatment gave the highest percentage of total acidity percentage (1.56 and 1.59%) in the two seasons, respectively. Concerning the effects of cultivars, results reveal that, the lowest acidity was found by H116 cultivar compared with Wonderful cultivar in the first season. In the second season, insignificant differences could be noticed between the two cultivars. Regarding the interaction effect of cultivars and treatments, data clarify that, the two pomegranate cultivars total acidity percentage of fruits were significantly decreased by spraying 200 ppm potassium silicate (1.27 and 1.26%) during both seasons, respectively.

2.2.3. Total sugars

Concerning total sugars, results in Table (7) show that, all treatments increased total sugars. However, the highest total sugars in the juice were obtained by fenugreek extract at 8 g/L (14.85 and 14.71%, respectively) in contrast to the other treatments in the two seasons. Regarding H116 and Wonderful pomegranate cultivars, data show that Wonderful cultivar gave higher total sugar percentage (14.57 and 14.47%) compared with the other cultivar in both seasons, respectively. The interaction between cultivars and treatments showes that Wonderful cultivar with 10 g /L SA recorded the highest values (17.17 and 16.90%) in contrast to the lowest values which were gained by control (11.19 and 11.15%) in both seasons, respectively.

2.2.4. Anthocyanin content

Concerning anthocyanin in the juice, data show significant differences in juice anthocyanin content with the different treatments. The treatment of 200 ppm potassium silicate gave the highest anthocyanin in the juice (30.50 and 29.83) in contrast to the lowest values observed by the control (22.33 and 21.50) in the two seasons, respectively. Also, data reveal that higher values of anthocyanin in juice were obtained by Wonderful cultivar (27.33 and 27.05) in both seasons. Regarding the interaction effect, the greatest anthocyanin content was obtained by Wonderful cultivar with 200 ppm potassium silicate treatment (31.00 and 30.67), in contrast to the lowest values observed in control (22.00, 21.00 and 22.67, 22.00) in both cultivars in both seasons, respectively.

DISSCUSION

Foliar application of 4 g/L fenugreek extract had a favorable outcome on total productivity with H116 pomegranate cultivar, number of arils / fruit, fruit juice (%), fruit sunburn (%) and weight of 100 arils (g). A similar trend was obtained by Azra (2011), who illustrated that using *Moringa oleifera* leaf

Table (7). Effect of spraying fenugreek extract, salicylic acid and potassium silicate on TSS (%), acidity (%), total sugars (%) and anthocyanin (mg/100 ml) of Wonderful and H16 pomegranate cultivars during 2018 and 2019 seasons.

Treatments	TSS (%)			Acidity (%)			Total sugars (%)			Anthocyanin (mg 100 mL)		
	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean	H16	Wonderful	Mean
Season 2018												
Control (untreated)	15.73de	15.53e	16.63D	1.62a	1.51b	1.56A	11.19h	12.47e	11.83F	22.00g	22.67g	22.33E
Fenugreek extract at 4 g/L	16.16b-e	16.07cde	16.11CD	1.36f	1.43d	1.39C	12.65e	13.27d	12.96D	26.00ef	27.33de	26.67C
Fenugreek extract at 8 g/	16.87bcd	16.57b-e	16.72BC	1.31g	1.32g	1.31E	13.37d	16.33b	14.85A	28.00cd	29.00bcd	28.50B
Salicylic acid at 5 g/L	16.70bcd	16.84bcd	16.77BC	1.43d	1.42d	1.43B	11.67g	14.33c	13.00D	25.00f	26.00ef	25.50CD
Salicylic acid at 10 g/L	18.09a	17.19abc	17.64A	1.35f	1.35f	1.35D	12.11f	17.17a	14.64B	29.00bcd	29.33abc	29.17B
Potassium silicate at 100 ppm	16.74bcd	15.56e	16.15CD	1.46c	1.39e	1.42B	11.35h	14.10c	12.72E	24.33f	26.00ef	25.17D
Potassium silicate at 200 ppm	17.28ab	16.73bcd	17.00AB	1.26h	1.27h	1.27F	14.16c	14.30c	14.23C	30.00ab	31.00a	30.50A
Mean	16.79A	16.36B		1.40A	1.38B		12.36B	14.57A		26.33B	27.33A	
Season 2019												
Control (untreated)	15.05f	15.63ef	15.34D	1.64a	1.54b	1.59A	11.15j	12.67g	11.91E	21.00f	22.00f	21.50D
Fenugreek extract at 4 g/L	15.90c-f	16.10b-f	16.00CD	1.35fg	1.40e	1.38C	12.63g	13.03f	12.83D	25.33de	26.67cd	26.00C
Fenugreek extract at 8 g/	16.88bcd	16.50b-e	16.69BC	1.30h	1.31h	1.30E	13.36e	16.07b	14.71A	25.67de	29.33ab	27.50B
Salicylic acid at 5 g/L	16.93bc	16.91bcd	16.92B	1.42de	1.43d	1.42B	11.65i	14.07d	12.86D	25.33de	25.67de	25.50C
Salicylic acid at 10 g/L	18.35a	17.16b	17.76A	1.34g	1.36f	1.35D	12.05h	16.90a	14.47B	27.67bc	28.67b	28.17B
Potassium silicate at 100 ppm	16.77b-e	15.71def	16.98B	1.45c	1.41e	1.43B	11.35j	14.13d	12.74D	24.00e	26.33cd	25.17C
Potassium silicate at 200 ppm	17.24 b	16.73 b-e	16.98 B	1.26 i	1.26 i	1.26 F	14.15 d	14.43 c	14.29 C	29.00 b	30.67 a	29.83 A
Mean	16.73 A	16.39 A		1.39 A	1.39 A		12.33 B	14.47 A		25.43 B	27.05 A	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

sprays on several crops at 3.5% increased all growth parameters. Also, El-Salhy et al. (2021) reported that spraying fenugreek seed sprout extract at 0.5% improved productivity and fruit quality (fruit weight, total sugars, and vitamin C) of mango trees three times in Aswan conditions. This result is in parallel with those of El-Gioushy and Baiea (2015) on canino, Faissal et al. (2014) on Wonderful pomegranate and Abd El-Hamied and El-Amary (2015) on pear trees. These findings also agree with the findings of Ahmed (2015), Allam (2017), Abdel-Razek (2019) and Farag (2019), who used extracts of seeds for improving fruit yield quality of crops.

The current study findings indicate that nearly all the applied substances enhanced the qualities of the two pomegranate varieties. As compared with the control, generally, 8 g /L fenugreek extract positively affected total chlorophyll, leaf N content, number fruits/tree and peel thickness of pomegranate cultivars. The obtained results are congruent with those found by Bassiony and Ibrahim (2016), who showed that moringa leaf extract markedly improved the leaf total chlorophyll, leaf mineral contents, N and cluster physical quality parameters of Flame seedless grape. Ahmed (2015) mentioned that foliar sprayed with fenugreek seed sprout extract at 0.5 to 2% enhanced growth and quality of "Keitte" mango under Aswan conditions, Egypt. Also, Phiri (2010) found that palant extract enhanced the growth and productivity of crops under stress conditions.

On the other hand, the results obtained regarding application of 10 g/L SA had a positive effect on total aril weight / fruit with Wonderful cultivar, TSS (%) of the two cultivars and fruit juice (%) of H116 cultivar. Results showed that applying SA to fruits one to three times improved the fruit physical characteristics of Sultani fig (Hamdy et al., 2019). These results are confirmed by those obtained by Amro et al. (2020), who reported that pomegranate "Wonderful" fruit quality was improved by SA treatments. Fruits' physical qualities were effectively improved by SA as reported by Karimi et al. (2012) on pistachio trees, Ayed (2014) on Manfalouty pomegranate trees, Ngullie et al. (2014) on mango and El-kenawy (2017) on grape. Concerning the positive effect of SA application on fruit physical properties, the results agree with the findings of Abd-El-Rhman and Attia (2016) and Ibrahim and Ali (2022), who mentioned that the improvement of physicochemical quality of Balady mandarin trees was obtained when planting them in sandy soil with three times a year treatment with 400 ppm of SA.

Foliar K application could alleviate some physiological disorders in pistachio trees as reported by Karmi et al. (2012). It was recorded that foliar K spray improved pomegranate cultivars' fruit quality and productivity (Hamouda et al., 2015). The effectiveness of K on reduced fruit cracking percentage in pomegranate was reported by Khalil and Aly (2013**)** and Davarpanah et al. (2017).

Regarding the spraying of 200 ppm potassium silicate, it gained the highest significant increase of leaves P and K percentages, fruit weight, fruit length, total yield of Wonderfull pomegranate cultivar. For H116, this treatment gave the highest total aril weight/fruit, fruit cracking (%), marketable fruits (%), total sugars (%), TSS (%) and anthocyanin, while decreasing total acidity (%). El Kholy (2018) reported that potassium silicate foliar application at 1.0 and 2.0% enhanced the percentages of fruit set and retention, resulting in a rise in fruit yield and its physical and chemical properties of Loquat trees. Also, Mohamed and Al-Kamar (2018) observed that spraying Olinda Valencia orange trees with potassium silicate at 2000 ppm improves the growth, yield and fruit quality. Aly et al. (2019) mentioned that foliar application of potassium silicate increases fruit yield parameters, number of fruits per tree, fruit weight and yield per kg/tree of mango trees. On the other hand, the same trend of these results of silicon was observed by Lalithya et al. (2013) on sapota, Costa et al. (2015) on Palmer mango, Świerczyński et al. (2022) on apple, Ibrahim and Al-Wasfy (2014) on Valencia orange and Ahmed (2023) on Sewy date palms.

CONCLUSION

From this experiment, it might be concluded that, spraying potassium silicate at 200 ppm had a beneficial role in enhancing Wonderfull pomegranate cultivar trees growth as well as leaves P and K content, fruit physical properties, fruit weight, fruit length, total yield, total aril weight/ fruit, fruit cracking (%) and marketable fruits (%). The obtained data also revealed the improvement of fruit's chemical composition in addition to total sugar percentage, TSS (%), anthocyanin and decreasing total acidity (%) under conditions of this study.

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تأثير الرش بمستخلص الحلبة وسليكات البوتاسيوم وحمض السالسيلك على محصول وجودة صنفين من ثمار الرمان تحت ظروف الأراضي المستصلحة

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أجريت هذه الدراسة خلال موسمين متتالين ٢٠١٨-٢٠١٩ على صنفي رمان الوندرفل وH116. إن الهدف من هذا البحث هو معرفة تأثير مستخلص بذور الحلبة وحمض الساليسيليك وسيليكات البوتاسيوم على المحتوى المعدني للأوراق وجودة الثمار، وقد وضع هذا البحث في تصميم القطع المنشقة (عاملين) حيث تم وضع المعاملات في قطع الأرض الرئيسية. تم تخصيص أصناف الرمان في قطع فرعية بأربعة مكررات تتكون من سبع معاملات كالتالي: شجرة بدون معاملة (المقارنة)، مستخلص بذور الحلبة بتركيز (٤ و٨ جرام/ اللتر)، حمض الساليسيليك بتركيزات (٥ و١٠ سم/ لتر) وسيليكات البوتاسيوم (١٠٠ و٢٠٠ جزء في المليون). تم رش الأشجار بعد العقد (في مايو) وتكرر مرة واحدة كل شهر من بداية شهر يونيو وحتى ما قبل الحصاد. أشارت النتائج المتحصل عليها إلى أن جميع المعاملات المختبرة أدت إلى زيادة معنوية سواء مستخلص بذور الحلبة أو حمض الساليسيليك أو سيليكات البوتاسيوم وتحسين معظم القياسات منها الكلوروفيل الكلي، العناصر الغذائية (N، P وK) في الأوراق، المحصول الكلي وكذلك الخصائص الفيزيائية للثمار (العدد، الطول، القطر، الوزن، سماكة القشرة، وزن ١٠٠ بذرة، عدد البذور، الوزن الكلي للبذور، عصير (٪)، حروق الشمس (٪)، التشقق (٪) والثمار القابلة للتسويق (٪) للثمار. بينما سيليكات البوتاسيوم أدت إلى تحسين الخصائص الكيميائية للثمار (مجموع المواد الصلبة الذائبة، الحموضة الكلية، نسبة السكريات الكلية، الأنثوسيانين الكلي) لصنفي الرمان تحت الدراسة. وعليه يمكن التوصية برش أشجار الرمان صنف وندرفل المثمرة بسليكات البوتاسيوم بتركيز ٢٠٠ جزء في المليون مما يكون له دور مفيد في تعزيز نمو الأشجار ونسبة الفسفور والبوتاسيوم في الاوراق والخصائص الفيزيائية للثمرة مثل وزن وطول الثمرة وزن البذور الكلية للثمرة وتقليل النسبة المئوية لتشقق الثمار وزيادة نسبة الثمار القابلة للتسويق وزيادة المحصول الكلي. كما أظهرت البيانات تحسن في الخواص الكيميائية للثمار مثل السكريات الكلية (٪)، TSS (٪)، الأنثوسيانين وانخفاض الحموضة الكلية (٪) تحت ظروف هذا البحث.