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Effect of Some Pre-Harvest Treatments on Quality of Fruit of Amal Apricot Cultivar

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Abstract: The present study was conducted at a private orchard at Regwa region, Giza governorate, Egypt during 2017 and 2018 seasons to examine the role of the pre-harvest application of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on apricot fruit quality after harvest in 2017 and 2018 seasons. The results indicated that all treatments significantly increased all fruit parameters in both seasons compared to the control. The data indicated that spraying apricot trees during pit hardening stage and 15 days before harvesting with 4.5 mmol/L SA + 4000 ppm PS gave the highest fruit weight, fruit diameters and flesh thickness in both seasons while Set at 2000 ppm had the highest fruit firmness in both seasons. Apricot trees treated with 4.5 mmol/L SA+4000 ppm PS gave the highest fruit TSS% and the lowest fruit acidity so the previous treatment increased fruit maturity index and this may be decrease fruit shelf life and accelerate maturity. While the lowest TSS/Acidity ratio (maturity index) was obtained by 1 mmol/L SA in both seasons. SA 1 mmol/L could be recommended to delay fruit ripening and extend fruit shelf life. Apricot trees treated with salicylic acid and potassium silicate as a single application or in combinations with others treatments significantly increased the mineral contents of apricot leaves.
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Key words: *Prunus arminiaca*, Salicylic acid, Potassium Silicate, Set (Ca 11.4%+B 0.7%), and Fruit quality

1. Introduction

Apricot, *Prunus armeniaca* L., is one of the most important stone fruits species in the world. It has a highly appreciated by consumers **(Ruiz and Egea 2008)**. Most production areas in Egypt are located in Beheira governorate. There is an expansion in the apricot cultivated area in Egypt. According to the available statistics, the total cultivated area in Egypt is 6652 (hectares) and the total production was estimated to be 99.841 tons in 2018 **(FAO, Stat. 2018).**

It is well known that apricot fruit starts to lose its physical and chemical quality (e.g. fruit firmness, increased fruit acidity and reduction in soluble solid content) directly after harvest and through the storage period **(Ezzat et al. 2012)**. The loss of firmness occurring during ripening is considered the key factor limiting this deterioration. In order to extend the postharvest period, the fruit is sometimes harvested before ripening and in spite of its climacteric nature it never reaches the optimal quality attributes for consumers **(Carmen et al., 2011)**. There were several substances could be used as a pre-harvest foliar application to enhance apricot fruit quality such as Salicylic acid, potassium silicate, calcium and boron.

Salicylic acid (SA) is a natural, hormone-like signal molecule that activates plant defenses. SA belongs to a group of phenolic compounds that are widely distributed in the plants and it is now considered as a hormonal substance, playing an important role in regulating plant growth and development in oxidative stress **(Senaratna et al., 2000)**. SA was extensively used for quality improvement in a number of crops where it significantly reduced the quality loss and/or chilling injury in apricot fruits **(Satraj et al. 2013).**

Potassium silicate is a source of highly soluble potassium and silicon. It is used in agricultural production systems primarily as a silica amendment and has the added benefit of supplying small amounts of potassium. In many horticultural crops, adequate potassium nutrition also contributes in enhancing fruit size, fruit color, soluble solids, and ascorbic acid concentrations and also improves shipping quality **(Kanai et al., 2007).**

In plants, silicon strengthens cell walls, improving plant strength, health, and productivity. Other benefits of silicon to plants include improving drought and frost resistance, decreasing lodging potential and boosting the plant's natural pest and disease fighting systems **(Prakash, 2007)**. Silicon has also been shown to improve plant vigor and physiology by improving root mass and density, and increasing above ground plant biomass and crop yields. Although not considered an essential element for plant growth and development (except for specific plant species -sugarcane and members of the horsetail family), silicon is considered a beneficial element in many countries throughout the world due to its many benefits to numerous plant species when under abiotic or biotic stresses. Silicon is currently under consideration by the Association of American Plant Food Control Officials (AAPFCO) for elevation to the status of a "plant beneficial substance" **(Stephen and Barker, 2009)**.

Calcium as a constituent of the cell wall plays an important role in forming cross-bridges which influences cell wall strength and is regarded as the last barrier before cell wall separation **(Fry, 2004)**. Exogenously applied calcium stabilizes the cell wall protection against the degrading enzymes **(White and Broadley, 2003)**. Application of calcium oxide in the form of Boramine-Ca or Klover-Cal-Bor, both of which also contain boron, resulted in firmer fruit than application of calcium oxide alone, the efficiency of exogenously applied calcium varies according to calcium fertilization studies on apricots **(Mohsen, 2011)**.

Mehta (2013) indicated that, foliar application of boron close to flowering time increased the number of flower clusters and increased boron content in apricot fruit and this did not result in any consistent improvement in fruit quality, although SSC increased in some cases.

There for this study aimed to determine the useful role of the pre-harvest spraying of salicylic acid, potassium silicate, calcium and boron in increasing apricot fruit quality.

2. Materials and Methods

The present study was conducted during two successive seasons 2017 and 2018 on 6 years old Amal cultivar apricot (*prunus armeniaca* L.). Trees were budded on local apricot rootstock and spaced at 4x5 m apart and grown under drip irrigation system in a private orchard at Regwa region, Giza governorate, Egypt.

Forty two uniform trees, free from various physiological and pathological disorders were selected for investigation, and received the standard agricultural practices. Soil texture and irrigation water analysis shown in (Table 1, 2 & 3). The trees were sprayed using a hand sprayer on two times. The first application time was at pet hardening (19th, 8th of April during 2017 and 2018 respectively), while the second application time was 15 days before harvesting at (2^{nd} May during 2017 and 27^{th} of April during 2018). Salicylic acid at 1, 1.5, 3 and 4.5 mmol/L, potassium silicate (PS) at 2000, 3000 and 4000 ppm, Set at 1000, 1500 and 2000 ppm, three combinations of Salicylic acid (SA) and potassium Silicate (PS) as follows, (SA 1.5 mmol/L + PS 2000 ppm, SA 3 mmol/L + PS 3000 ppm and SA 4.5 mmol/L + PS 4000 ppm) and the control treatment was sprayed with tape water. One tree represented as one replication and three replicates were used for each treatment. The studied treatments were arranged in randomized complete block design. Selected fruits were picked in field boxes and then sorted well to discard any defective fruits due to mechanical or pathological disorders. Uniform fruits in size and color washed with tape water, and then divided into 30 equal batches of about 6 kg. Each batch was packed in a wood tray at the dimensions of 50,30and 5 cm. Fruits of each three trays (three replicates) were subjected to the following measurements:

Table (1): Chemical properties of the experimental soil:

Cations (mEq /L)				Anions (mEq /L)				SP	EC (ds/m)	PH 1:2.5
K^+	Na^+	Mg^{+2}	Ca^{+2}	$SO4^{2-}$	Cl^-	HCO^{3-}	$CO3^{2-}$			
1.0	5.6	5.0	5.4	4.0	12.0	1.0	-	22.0	1.89	7.83

Table (2): The mechanical analysis, soil texture, wilting point and field capacity of the experimental soil.

W.P %	F.C %	Texture	Volumetric classification of soil grains %			
			Clay	Celt	Soft sand	Rough sand
7.5	10.3	Loam sand	4.5	14.8	42.2	38.5

1- Physical properties:

1-1- Fruit weight (g), dimensions, firmness (Ib/in^2) and flesh thickness (mm):

The weight of 10 fruits of each replication was determined and average was taken. Fruit length (cm), fruit diameter (cm) and flesh thickness (mm) were measured using a Vernier caliper. Fruit firmness was determined as (Ib/in^2) using a pocket pressure tester (**Watkins and Harman, 1981**).

2- Chemical analyzes:

2-1- Total soluble solids (TSS%), Total acidity (%) and TSS/acid ratio:

TSS % was determined in apricot fruit juice using a hand refractometer according to (A.O.A.C 2005). The acidity was color metrical measured based on estimated malic acid using five milliliters of the fruit juice of each fruit sample and titrated with Sodium hydroxide solution of a known normality using Phenolphthalein as an indicator (A.O, A, C. 2005). The results of these titrations were converted to percent of titratable acidity using the following equation: percent of titratable.

Where: **0.067=** mille equivalent factor of Malic acid

TSS/acid ratio was calculated as a ratio between TSS (%) and acidity (%) and considered as a maturity index (MI).

Table (3): Analysis of irrigation water used in the study.

Total dissolved soils (TDS)	
EC (deciSiemens/meter)	1.1
EC (PPM)	704.0
PH	7.50
Dissolved anions (mEq /L)	
Carbonate ($CO3^{2-}$)	-
Bicarbonate (HCO^{3-})	0.3
Chloride (Cl^{-})	10.1
Sulfate ($SO4^{2-}$)	0.6
Dissolved cations (mEq /L)	
Calcium (Ca^{+2})	2.0
Magnesium (Mg^{+2})	1.4
Sodium (Na^{+})	7.3
Potassium (K^{+})	0.3
Residual Sodium carbonate (RSC)	-
Sodium adsorption ratio (SAR)	5.61

$$Acidity = \frac{[mls\ NaOH\ used]x\ [0.1N\ NaOH]x\ 0.067\ x[100]}{Juice\ used\ (ml)}$$

2-2- Leaves mineral contents:

Leaves N, P and K contents were determined in June, total nitrogen was assayed according to **Chapman and Pratt (1961)** and **Cottenie et al. (1982**) using the micro kjeldahl apparatus. Phosphorus was determined using spectrophotometers according to **cottenie et al (1982**). Potassium was determined photometrically, using flame photometer according to **Jackson (1965).** Ca, Mn and Zn were determined by flame photometer also.

2-3- Total chlorophyll content:

Leaves samples were taken in June to determine leaf chlorophyll content and three replicates for each treatment were used. Leaves total chlorophyll content was determined spectrophotometrically according to Wellburn (**1994**).

Statistical analysis:

All data were subjected to the analyses of variance (ANOVA) for randomized block design RCBD design followed by compared means with LSD at level probability 5% according to **Gomez and Gomez (1984)** using **Costat (2005)** computer software package.

3. Results and Discussion

1- Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (PS), Set and their combinations on apricot fruit physical properties in 2017 and 2018 seasons.

The obtained results in (Table 4) indicated that spraying apricot trees with **4.5 mmol/L SA + 4000 ppm PS** showed the highest fruit weight (26.61g and 26.66g), fruit length (3.96cm and 4.26 cm), fruit diameters (4.22 and 4.29 cm) and fruit thickness (0.89cm and 1.10 cm) in both seasons, respectively and also, this treatment gave the highest shape index in the second season. The superiority of **4.5 mmol/L SA + 4000 ppm PS** treatment did not differ significantly with those obtained by **3 mmol/L SA + 3000 ppm PS, 1.5 mmol/L SA + 2000 ppm PS and 4000 ppm PS** in all previous traits in both seasons. In the same way the apricot trees that sprayed with **2000 ppm Set compound** gave the highest fruit firmness with averages of (13.78 and 13.71 Lb/inch2) respectively but these values did not differ significantly with those obtained by **1500 ppm of Set compound** in both seasons. On the other hand, the untreated control resulted in the lowest fruit weight (21.06 and 21.34000 ppm), fruit length (2.91 and 2.98cm), fruit diameters (3.06 and 3.17cm), fruit thickness (0.57 and 0.59cm) and fruit firmness (12.54 and 12.49) in 2017 and 2018 seasons, respectively. Finally, the result showed that apricot trees sprayed with **3000 ppm P.S** gave the highest shape index in 2017 season.

In all cases salicylic acid and potassium silicate alone or combined significantly increase all fruit parameters and this may due to the highly nitration values in the leaves where the same treatments significantly increase all macro and micro nutrients and total chlorophyll in apricot leaves (Table 6).

Table (4): Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on apricot fruit traits in 2017 and 2018 seasons.

Treatment	Fruit Weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Shape index	Flesh Thickness (cm)	Firmness (Lb/inch^2)
2017						
Control	21.06 g	2.91	3.06	0.951 b-d	0.57 c	12.54 d
1 mmol/L SA	23.33 f	3.14	3.27	0.960 b	0.58 c	13.64 a-c
1.5 mmol/L SA	23.45 ef	3.23	3.46	0.934 f	0.63 bc	12.73 d
3 mmol/L SA	23.76 ef	3.47	3.66	0.948 b-e	0.67 a-c	12.79 cd
4.5 mmol/L SA	23.87 d-f	3.58	3.78	0.947 c-e	0.69 a-c	12.39 d
2000 ppm P.S	25.11 a-f	3.67	3.88	0.946 c-f	0.74 a-c	12.76 cd
3000 ppm P.S	25.43 a-e	3.87	3.97	0.975 a	0.78 a-c	12.89 b-d
4000 ppm P.S	25.81 a-d	3.91	4.12	0.949 b-e	0.81 a-c	12.85 cd
1000 ppm Set	24.12 c-f	3.61	3.81	0.948 b-e	0.71 a-c	13.22 a-d
1500 ppm Set	24.36 b-f	3.68	3.89	0.946 c-f	0.72 a-c	13.74 ab
2000 ppm Set	24.48 b-f	3.69	3.89	0.949 b-e	0.73 a-c	13.78 a
1.5 mmol/L SA+2000 ppm PS	26.07 a-c	3.89	4.07	0.956 bc	0.85 ab	12.87 b-d
3 mmol/L SA+3000 ppm PS	26.22 ab	3.92	4.17	0.940 d-f	0.88 ab	12.89 b-d
4.5 mmol/L SA+4000 ppm PS	26.61 a	3.96	4.22	0.938 ef	0.89 a	12.94 a-d
LSD 0.5	**1.73**	**0.72**	**0.72**	**0.013**	**0.22**	**0.77**
2018						
Control	21.34 h	2.98	3.17	0.940 ef	0.59 e	12.49 c-f
1 mmol/L SA	23.42 g	3.16	3.38	0.935 f	0.69 de	12.61 cd
1.5 mmol/L SA	23.65 fg	3.32	3.53	0.941 ef	0.71 c-e	12.57 cd
3 mmol/L SA	23.89 e-g	3.63	3.75	0.968 b	0.73 c-e	12.52 c-e
4.5 mmol/L SA	23.98 e-g	3.75	3.88	0.966 bc	0.79 b-e	12.42 c-g
2000 ppm P.S	25.26 cd	3.91	4.12	0.949 d	0.85 b-d	12.35 d-g
3000 ppm P.S	25.55 bc	3.99	4.19	0.952 d	0.89 a-d	12.76 c
4000 ppm P.S	25.87 a-c	4.08	4.22	0.967 bc	0.91 a-d	12.77 c
1000 ppm Set	24.32 e-g	3.66	3.87	0.946 de	0.78 b-e	13.17 b
1500 ppm Set	24.54 d-f	3.76	3.91	0.962 bc	0.81 b-e	13.65 a
2000 ppm Set	24.66 de	3.81	3.97	0.960 c	0.85 b-d	13.71 a
1.5 mmol/L SA+2000 ppm PS	26.11 a-c	4.19	4.21	0.995 a	0.93 a-c	12.18 e-g
3 mmol/L SA +3000 ppm PS	26.34 ab	4.22	4.23	0.998 a	1.00 ab	12.11 fg
4.5 mmol/L SA+4000ppm PS	26.66 a	4.26	4.29	0.993 a	1.10 a	12.05 g
New LSD 0.5	**0.98**	**0.67**	**0.59**	**0.008**	**0.24**	**0.38**

Our findings indicated that salicylic acid + potassium silicate increased all apricot fruit physical parameters weight, length, thickness and diameters and theses finding in agree with those of **Jaishankar et al., (2018)** found that, the pre-harvest spray of 6000 ppm potassium silicate was found to increase apple fruit weight, length, breadth, volume and specific gravity compared other treatments. Similar results were obtained by **Ravishankar and Jagadeesh (2017)** in banana and **El Kholy et al., (2018)** in loquat.

Our results showed that the application of **Set** significantly increase apricot fruit firmness compared with all studies treatments. Many authors studied the role of calcium and boron in enhancing fruit physical properties such as **Swathi et al., (2019)** who reported that Calcium and boron treatments showed positive influence on TSS (17.9 to 15.9 Brix0), juice pH (3.92 to 3.75), titrable acidity (0.91 to 1.19%), total solids (1.32 to 1.07%), berry firmness (11.9 to 7.95 N) and total sugars (15.6 to 11.2%). Also, **Abdrabboh, (2012)** showed that, pre-harvest application with Calcium nitrate at 20000 ppm was the best treatment for improving fruit quality by increasing fruit firmness under cold storage condition of apricot fruits. Similar results were obtained by **El -Shazly et al., (2013)** in peach fruits and **Abd and Wahab (2015)** in apricot fruit.

2- Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on chemical properties of apricot in 2017 and 2018 seasons.

The presented data in (Table 5) confirmed that total soluble solid (TSS), acidity and TSS/Acidity of apricot fruits differed significantly under all spray treatments in the two seasons. As for TSS% the data indicated that treated apricot trees with **4.5 mmol/L SA+4000 ppm PS** gave the highest TSS% in fruits (15.65 and 15.58) followed by **3 mmol/L SA +3000 ppm PS** (15.62 and 15.31) then **1.5 mmol/L SA + 2000 ppm P.S** (15.53 and 15.37) in both seasons, respectively and the insignificant differ were detected among the three treatments in this trait. In the same line the lowest fruit acidity were obtained by spraying apricot trees with **4.5 mmol/L SA+4000 ppm PS** (0.73 and 0.78) followed by **3 mmol/L SA +3000 ppm PS** (0.73 and 0.79) then **1.5 mmol/L SA + 2000 ppm P.S** (0.73 and 0.79) in 2017 and 2018 seasons respectively. Also, the insignificant differences were obtained between these treatments in the two seasons. Regarding to TSS/Acidity the result indicated that the highest TSS/Acidity ratio were presented in apricot fruits that treated with **4000 ppm PS** (22.00) in the 1st season and from apricot trees that treated with **4.5 mmol/L SA+4000 ppm PS** with an average of 19.87 in the 2nd season. On the other side, the result showed that spraying apricot trees with **1 mmol/L SA** gave the lowest TSS% (12.56 and 12.36), the highest fruit acidity (1.04 and 1.08) and the lowest TSS/Acidity ratio with averages of 12.01 and 11.39 in 1st and 2nd seasons, respectively.

The increase of fruit quality under salicylic and potassium spray may resulted in the increase of macro and micro nutrients in the leaves and this are clear in Table 6 where both Salicylic acid and potassium silicate significantly increased leaf contents of macro and micro nutrients and total chlorophyll in both seasons. Also, maturity index negatively associated with fruit firmness and titratable acidity and this could be clear evidence that salicylic acid and potassium silicate seemed to be excellent treatments that used to delay apricot fruit ripening.

Table (5): Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on apricot fruit chemical properties in 2017 and 2018 seasons.

Treatment	TSS%	Acidity%	TSS/Acid ratio
2017			
Control	13.12 d-f	0.92 b	14.23 h
1 mmol/L SA	12.56 g	1.04 a	12.01 j
1.5 mmol/L SA	12.81 fg	1.04 a	12.30 ij
3 mmol/L SA	12.93 e-g	1.04 a	12.40 I
4.5 mmol/L SA	13.34 d-e	0.91 b	14.60 g
2000 ppm P.S	14.90 b	0.86 b	17.32 d
3000 ppm P.S	15.28 ab	0.81 cd	18.76 c
4000 ppm P.S	15.44 a	0.77 de	22.00 a
1000 ppm Set	13.71 c	0.88 b	15.56 e
1500 ppm Set	13.62 c	0.88 b	15.45 ef
2000 ppm Set	13.46 cd	0.88 b	15.23 f
1.5 mmol/L SA +2000 ppm PS	15.53 a	0.73 e	21.23 b
3 mmol/L SA +3000 ppm PS	15.62 a	0.73 e	21.36 b
4.5 mmol/L SA +4000 ppm PS	15.65 a	0.73 e	21.36 b
LSD 0.5	**0.42**	**0.06**	**0.37**
2018			
Control	12.92 e-g	0.94 a-c	13.72 h
1 mmol/L SA	12.36 h	1.08 a	11.39 j
1.5 mmol/L SA	12.53 gh	1.07 a	11.68 j
3 mmol/L SA	12.74 f-h	1.04 ab	12.21 i
4.5 mmol/L SA	13.11 d-f	0.96 a-c	13.65 h
2000 ppm P.S	14.66 b	0.85 a-c	17.18 e
3000 ppm P.S	14.82 b	0.83 a-c	17.83 d
4000 ppm P.S	15.25 a	0.81 bc	18.54 c
1000 ppm Set	13.43 cd	0.89 a-c	15.06 g
1500 ppm Set	13.51 c	0.87 a-c	15.52 f
2000 ppm Set	13.24 c-e	0.86 a-c	15.34 fg
1.5 mmol/L SA +2000 ppm PS	15.37 a	0.79 bc	19.36 b
3 mmol/L SA +3000 ppm PS	15.31 a	0.79 bc	19.36 b
4.5 mmol/L SA +4000 ppm PS	15.58 a	0.78 c	19.87 a
LSD 0.5	**0.41**	**0.26**	**0.36**

In this study salicylic acid resulted in significant increase TSS and acidity percentage and decrease TSS/Acidity ratios in apricot fruit in both season, so salicylic acid could be recommended to delay fruit ripening and extend fruit shelf life. Similar results were obtained before by **Attri *et al.*, (2014)** they revealed that peach fruits treated with salicylic acid and calcium had significantly increase the TSS, acidity, ascorbic acid and sugars in treated peaches with salicylic acid remained intact, whereas in untreated fruits, the conversion rate was faster. **Rab *et al.*, (2017)** found that, in apricot fruit the control fruit had the maximum TSS/Acid ratio while, fruit sprayed with 2.5 mM salicylic acid had the highest acidity.

Also, in this study potassium silicate had excellent effect in the TSS, acidity and TSS/acidity ratio of apricot fruit, and this may be decrease fruit shelf life and accelerate maturity. These findings are in harmony with those by, **Ben Mimoun *et al.*, (2009)** they found that, potassium sulphate 3% increased significantly acidity and TSS of Peach. **Kaur *et al.*, (2012)** reported that, the application of 2.0 per cent sprays of potassium nitrate increased the peach fruits TSS and TSS: acidity ratio. **El Kholy *et al.*, (2018)** indicated that the tested potassium silicate treatments enhanced total soluble solids (TSS)%, total acidity (TA) %, TSS/TA ratio of Loquat fruits.

3- Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on some important nutrients values of apricot leaves in 2017 and 2018 seasons.

The results in (Table 6) indicated that most foliar spray treatments significantly increased all leaf useful nutrients N, P, K, Ca, Zn, and Mn in both seasons compared with the control treatments except for P and K in the 1st season and P in the 2nd season. For nitrogen content the result showed that the highest content of N were obtained from apricot trees that treated with **2000 ppm P.S** (2.98) followed by **1.5 mmol/L SA +2000 ppm P.S** (2.93) then **2000 ppm Set** (2.86) in the first season, while the highest nitrogen in the 2nd season were presented in apricot trees that treated with **2000 ppm P.S** (3.07) followed by **1.5 mmol/L SA +2000 ppm P.S** (2.99) then **4.5 mmol/L SA** (2.94). In the contrast of this the lowest contents of nitrogen were shown under the control treatment with averages of 1.69 and 1.59 in both seasons, respectively.

With respect to Phosphor content the result indicated that the highest leaves content of P were obtained from apricot trees under the control treatment (0.29 and 0.26) followed by **4.5 mmol/L SA + 4000 ppm PS** (0.23 and 0.25) in both seasons, respectively then **3 mmol/L SA +3000 ppm P.S** (0.22) in the 1st season and 4.5 mmol/L SA (0.25) in the 2nd season. On the other hand the lowest contents of Phosphor were shown under 1 mmol/L SA treatment with averages of 0.14 and 0.13 in both seasons, respectively.

Regarding to potassium content the result showed that the highest leaves content of K were obtained from apricot trees that treated with **1.5 mmol/L SA + 2000 ppm P.S** (4.51) followed by control (4.32) then **4000 ppm PS** (4.22) in the first season, while the highest Potassium contents in the apricot leaves in the 2nd season were presented in apricot trees that treated with **4000 ppm PS** (4.76) followed by **1.5 mmol/L SA +2000 ppm P.S** (4.56) then **3000 ppm P.S** (4.56). On the other side, the lowest contents of Potassium were shown from **1 mmol/L SA** treatment with averages of 3.08 and 3.18 in both seasons, respectively.

As for Calcium content the result showed that the highest leaves content of Ca were obtained from apricot trees that treated with **1.5 mmol/L SA +2000 ppm P.S** (3.31) followed by **1000 ppm Set** (3.27) then **3 mmol/L SA +3000 ppm PS** (3.21) in the first season, while the highest Calcium contents in the apricot leaves in the 2nd season were presented in apricot trees that treated with **4000 ppm P.S** (3.56) followed by **1.5 mmol/L SA +2000 ppm P.S** (3.38) then **2000 ppm P.S** (3.37). On the other side, the lowest leaves contents of Ca were shown from **1 mmol/L SA** treatment with an average of 2.11 in the 1st season and 4.5 mmol/L SA with an average of 2.32 in the 2nd season.

For Zinc content the result showed that the highest leaves content of Zn were obtained from apricot trees that treated with **1.5 mmol/L SA +2000 ppm P.S** (23.03 and 23.33) followed by **3 mmol/L SA +3000 ppm PS** (19.90 and 20.10) then **4.5 mmol/L SA + 4000 ppm PS** (19.49 and 20.10) in the 1st and 2nd season, respectively. On the other side, the lowest contents of Zn were obtained from **4.5 mmol/L SA** treatment with averages of 10.40 and 10.40 in both seasons, respectively.

For Manganese content the result showed that the highest leaves content of Mn were obtained from apricot trees that treated with **1.5 mmol/L SA +2000 ppm P.S** (90.50 and 90.80) followed by **2000 ppm P.S** (89.39 and 90.80) then **3 mmol/L SA** (84.84 and 89.18) in both seasons, respectively. In the contrast of this, the lowest leaves contents of Manganese were obtained from **3000 ppm P.S** treatment with averages of 61.31 and 61.41 in both seasons, respectively.

Table (6): Effect of pre-harvest applications of Salicylic acid (SA), Potassium Silicate (P.S), Set and their combinations on some important nutrients values of apricot leaves in 2017 and 2018 seasons.

Treatment	N	P	K	Ca	Zn	Mn	Chlorophyll
2017							
Control	1.69 e	0.29 a	4.32 ab	2.39 cd	16.46 e	80.50 c	46.26 bc
1 mmol/L SA	2.34 d	0.14 f	3.08 f	2.11 d	14.95 f	73.93 d	45.09 cd
1.5 mmol/L SA	2.81 a-c	0.16 e	3.95 c-e	2.27 d	11.72 j	83.83 b	48.37 a
3 mmol/L SA	2.78 a-c	0.16 e	3.70 e	2.43 b-d	10.61 k	84.84 b	41.20 fg
4.5 mmol/L SA	2.83 a-c	0.21 c	3.21 f	2.07 d	10.40 k	81.81 c	43.51 de
2000 ppm P.S	2.98 a	0.19 d	4.11 bc	3.01 a	14.14 g	89.39 a	36.91 i
3000 ppm P.S	2.78 a-c	0.19 d	4.17 bc	3.06 a	12.22 i	61.31 i	39.16 h
4000 ppm P.S	2.61 cd	0.19 d	4.22 a-c	3.14 a	13.74 h	65.55 g	45.29 c
1000 ppm Set	2.59 cd	0.19 d	3.89 c-e	3.27 a	14.24 g	63.83 gh	42.38 ef
1500 ppm Set	2.66 b-d	0.19 d	3.76 de	2.88 a-c	14.04 g	62.72 hi	41.53 f
2000 ppm Set	2.86 a-c	0.19 d	3.65 e	2.95 ab	17.68 d	69.94 e	47.58 ab
1.5 mmol/L SA+2000 PS PSA+2000P.S Pppm P.S	2.93 ab	0.21 c	4.51 a	3.31 a	23.03 a	90.50 a	48.92 a
3 mmol/L SA+3000 P.S	2.71 a-c	0.22 bc	4.11 bc	3.21 a	19.90 b	74.34 d	34.90 j
4.5 mmol/L SA+4000P.S P.Sppm PS	2.73 a-c	0.23 b	4.09 b-d	3.19 a	19.49 c	67.87 f	39.52 gh
LSD 0.5	**0.37**	**0.02**	**0.39**	**0.57**	**0.33**	**1.78**	**1.97**
2018							
Control	1.59 h	0.26 a	4.46 b	2.66 d	17.88 c	82.12 d	47.17 bc
1 mmol/L SA	2.22 g	0.13 f	3.18 h	2.53 de	15.35 d	75.55 e	46.12 bc
1.5 mmol/L SA	2.84 c-e	0.17 e	3.99 d	2.67 d	11.92 i	87.87 b	49.29 a
3 mmol/L SA	2.89 b-d	0.16 e	3.84 e	2.88 c	11.01 j	89.18 b	41.47 fg
4.5 mmol/L SA	2.94 bc	0.25 ab	3.47 g	2.32 e	10.40 k	85.85 c	44.00 de
2000 ppm P.S	3.07 a	0.20 d	4.47 b	3.37 b	14.44 f	90.80 a	36.72 h
3000 ppm P.S	2.89 b-d	0.20 d	4.56 b	3.34 b	12.93 h	61.41 h	40.18 g
4000 ppm P.S	2.79 d-f	0.20 d	4.76 a	3.56 a	14.04 g	65.35 g	45.55 cd
1000 ppm Set	2.71 f	0.20 d	3.98 de	3.06 c	14.75 e	64.74 g	43.01 ef
1500 ppm Set	2.85 cd	0.20 d	3.91 de	3.28 b	14.34 f	64.03 g	42.25 f
2000 ppm Set	2.89 b-d	0.20 d	3.65 f	3.33 b	18.08 c	70.49 f	47.48 b
1.5 mmol/L SA+2000 PS ppm P.S	2.99 ab	0.21 cd	4.56 b	3.38 ab	23.33 a	90.80 a	49.95 a
3 mmol/L SA+3000 PS	2.71 f	0.23 bc	4.18 c	3.34 b	20.10 b	74.84 e	36.06 h
4.5 mmol/L SA+4000 PS ppm PS	2.73 ef	0.25 ab	4.15 c	3.32 b	20.10 b	68.78 f	39.79 g
LSD 0.5	**0.14**	**0.03**	**0.17**	**0.24**	**0.32**	**1.89**	**1.84**

With respect to total chlorophyll content the result showed that the highest leaves content of total chlorophyll were obtained from apricot trees that treated with **1.5 mmol/L SA +2000 ppm P.S** (48.92) followed by **1.5 mmol/L SA** (48.37) then **2000 ppm Set** (47.58) in the first season, while the highest chlorophyll contents in the 2nd season were presented in apricot trees that treated with **1.5 mmol/L SA +2000 ppm P.S** (49.95) followed by **1.5 mmol/L SA** (49.29) then **2000 ppm Set** (47.48). In the contrast of this the lowest contents of chlorophyll were shown from **3 mmol/L SA+3000 ppm PS** treatment (34.90) in the 1st season and **2000 ppm P.S** in the 2nd season with an average of 36.72. From the previous result it could be clear that sprayed apricot trees with **1.5 mmol/L SA+2000 ppm P.S** seemed to be excellent treatment which enhanced all leaves nutrient in both seasons except phosphor contents.

Our results showed that salicylic + potassium silicate gave the highest apricot leaves nutrients N, P, K, Ca, Mg, Zn and chlorophyll contents in both seasons. These finding are in agreed with those obtained by **Ben Mimoun et al., (2009)** they found that, potassium sulphate 3% increased significantly N, P, K, Mg and Ca of Peach and Plum. **Sotiropoulos et al., (2010)** showed that, foliar application of KNO3, Agriphos (P 33%, K 28%), Chelan-K, Silene-K on "Andross" peaches significantly increased macro nutrient (N, P, K) content over the control. **Dutta et al., (2011)** indicated that, potassium sulphate increased N, P, K, Zn, and Mn of Mango content and decreased titratable acidity of fruits than that of control.

Conclusion

The result of this study indicated that spraying apricot trees with **4.5 mmol/L SA + 4000 ppm PS** as a pre-harvest treatment significant increased apricot fruit physical and chemical properties after harvest. Hence, spray potassium and salicylic as a field application could be recommended at the recommended rates in this experiment to raise the quality of fruits.

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