# Effect of spraying with ascorbic and salicylic acids for some quantitative traits in pomegranate *Punica granatum* L.

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## Abstract

This experiment was conducted in one of the private orchards in the northeast of Halabja city during the growing season (2019). In order to study the effect of foliar spraying with ascorbic acid at a concentration of (0, 750, 1500) $mg.L^{-1}$ and salicylic at a concentration of (0, 75, 150) $mg.L^{-1}$ on some quantity traits of pomegranate cultivar Saleh Khani. The trees were sprayed with ascorbic and salicylic acids until completely wet using 0.01% of liquid soap as a diffuser on the first three dates on 04/23/2019, the second on 06/26/2019, and the third on 7/26/2019. The experiment was conducted according to Randomized Complete Block Design (RCBD) with three replicates within the factorial experiments and with two factors. The results obtained can be summarized as follows: For ascorbic acid, it was found that spraying with a concentration of 750 $mg.L^{-1}$ of ascorbic acid was significantly superior to the control treatment in the average fruit weight (364.144 g),While in salicylic acid, spraying with a concentration of 75 $mg.L^{-1}$ of salicylic acid resulted in a significantly excelled control treatment in the average yield of one tree (69.577 $kg.tree^{-1}$).While this concentration reduced the percentage of fruit drop (3.340%) compared to the control treatment .Also, the interaction of 750 $mg.L^{-1}$ of ascorbic acid with 75 $mg.L^{-1}$ of salicylic acid was significantly excelled on the control treatment as it led to an increase in the average yield of the fruit and led to a decrease in the percentage of fruits drop.

**Key words: ascorbic acid, salicylic acid, pomegranate.**

# تأثير الرش بحامضي الأسكوربيك والسالسليك لبعض الصفات الكمية في الرمان L. *Punica granatum*

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الخلاصة

أجريت هذه التجربة في أحد البساتين الخاصة الواقعة شمال شرق مدينة حلبجة. خلال موسم النمو (2019)، بهدف دراسة تأثير الرش الورقي بحامضي الأسكوربيك بتركيز (0، 750، 1500) ملغم.لتر$^{-1}$ والسالسليك بتركيز (0، 75، 150) ملغم.لتر$^{-1}$ في بعض صفات الكمية للرمان صنف ساله خانى، فقد رشت الاشجار بحامضي الأسكوربيك والسالسليك حتى البلل التام بأستخدام 0.01% من الصابون السائل كمادة ناشرة في المواعيد الثلاثة الاول بتاريخ 23/4/2019 والثانية 26/6/2019 والثالثة 26/7/2019. ونفذت التجربة وفق تصميم القطاعات العشوائية الكاملة بثلاث قطاعات ضمن التجارب العاملية وبعاملين. ويمكن تلخيص النتائج التي تم الحصول عليها فيما يلي: بالنسبة لحامض الأسكوربيك تبين أن الرش بتركيز 750 ملغم.لتر$^{-1}$ من حامض الأسكوربيك قد تفوق معنوياً على معاملة المقارنة في متوسط وزن الثمرة (364.144 غم) ، بينما في حامض السالسليك أدى الرش بتركيز 75 ملغم.لتر$^{-1}$ من حامض السالسليك الى تفوق معنوي على معاملة المقارنة في متوسط حاصل الشجرة الواحدة (69.577 كغم.شجرة$^{-1}$) ، بينما أدى هذا التركيز الى التقليل من نسبة الثمار المتساقطة (3.340 %) قياساً بمعاملة المقارنة ، كما ان التداخل 750 ملغم.لتر$^{-1}$ من حامض الأسكوربيك مع 75 ملغم.لتر$^{-1}$ من حامض السالسليك قد تفوق معنوياً على معاملة المقارنة حيث أدى الى زيادة في متوسط حاصل الثمرة وأدى الى تقليل من نسبة الثمار المتساقطة .

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## Introduction

Pomegranate belongs to *Punica granatum* L., the fruit of the Punicaceae family and another type is known as the ornamental pomegranate, which is grown in home gardens as an ornamental tree, due to the beauty of its multi-petaled and brightly colored flowers (Al-Duri and Al-Rawi, 2000). Iran is the main producer of pomegranate fruits, followed by India, Turkey and Spain (Owis, 2010). Pomegranate ranks second after grapes in Iraq with 160,124 tons (28.30%) (Iraqi Central Bureau of Statistics 2018). Pomegranate is used in Iraq to prepare pomegranate juice and manufacture pomegranate molasses. Pomegranate cultivation is widespread in Iraq due to the appropriate climatic conditions and the availability of sunlight. 23 types of pomegranate are cultivated in Iraq, the most prominent of which are (Salimi, Sala Khani, Sweet Pomegranate, Musaqeb, and Nab Camel) (Al-Jaf 2016), Pomegranate fruits are of great importance because they contain good amounts of vitamins, especially vitamin C, as well as many pigments, fats, carbohydrates, acids, fiber, protein, and many nutrients. Phenolics) which have been shown to be effective as antagonists and inhibitors for many pathogens, (Opara et al., 2009).Recently, it was suggested to use antioxidants to improve the yield and production of organic fruits in various types of fruits.Antioxidants, especially salicylic acid, are safe for humans and the environment and play an important role in protecting cells from aging and have beneficial effects on catching (chelating) free radicals or hydroxyl radicals and ozone. Leaving these free radicals without chelation or catching leads to the oxidation of fats. Many studies have also proven that ascorbic acid has many roles and functions, including its role in activating and regulating the work of a number of enzymes that it needs as a co-factor .Especially enzymes related to the manufacture of plant hormones such as ethylene and gibberellin (Gara, 2005).It is also one of the substances that help regulate plant growth and development, due to its positive effect on the division, expansion and specialization of cells (Blokhina et al., 2003), It also has a central role in the processes of photosynthesis and respiration, especially when it is in the highest ideal concentration in chloroplast (Smirnoff, 1996),It plays an important role in the electron movement and transport system (El-Kobisy et al., 2005), and it has the ability to give electrons to a wide range of enzymatic and non-enzymatic reactions in cells (Blokhina et al., 2003), In view of the importance of the issue of pomegranate fruit cracking and its being one of the most serious problems that cause the non-proliferation of pomegranate and the reason for reducing its production in Iraq, therefore, spraying with salicylic and ascorbic acids was chosen to know the effect of both acids in improving some quantitative characteristics of Sala Khani cultivar pomegranate.

## Materials and methods

### Experiment location:

This experiment was conducted in one of the private orchards located in the northeast of Halabja city, during the growing season (2019) to study the effect of foliar spraying with salicylic and ascorbic acids on the yield of pomegranate trees.

### Selecting trees and conducting agricultural service operations:

The study was conducted on pomegranate trees at the age of 10 years, and the trees were of good growth, almost identical in size, and free from diseases and insects, in a random method. The trees were planted in a quadrilateral manner, with distances of 3 meters. The necessary agricultural service operations were conducted for all trees, such as removing bushes and crabs, plowing the soil and pruning, and irrigating the trees according to the trees' needs.

### Experiment design:

The factorial experiment was conducted according to a randomized complete block design (RCBD) with three replicates, and one

 ISSN 2072-3875

replicate includes nine treatments.The treatments were randomly distributed within each replicate and according to one tree for the experimental unit, thus the total trees used in the experiment were 27 trees.

The research includes the study of two factors:

The first factor: spraying trees with ascorbic acid at three concentrations (0, 750 and 1500) $mg.L^{-1}$.

The second factor: spraying trees with salicylic acid at three concentrations (0, 75 and 150) $mg.L^{-1}$.

The trees were sprayed with the mentioned concentrations of the two acids three times. As for the control trees, they were sprayed with distilled water and the diffuser only, the first before flowering (23/4/2019 salicylic acid was sprayed) (24/4/2019 ascorbic acid was sprayed)and the second after the contract was completed (26/6/2019 salicylic acid was sprayed) (27/6/2019 ascorbic acid was sprayed) and the third was a month after the second spray (26/7/2019).Salicylic acid was sprayed (27/7/2019 ascorbic acid was sprayed) according to the treatments.Loss of plasma membrane permeability and cell death with plant tissues, as it is also responsible for promoting natural hormones that play a key role in regulating plant growth and development (Senarataa et al., 2004),Several studies showed the positive effects of using salicylic acid in improving the yield and fruit quality of different fruit crops (Wassel et al., 2011).

**Studied traits:**

**Average fruit weight (g):**

It was estimated as an average of the weights of ten fruits collected randomly at harvest and represented the fruits of the tree (experimental unit), after being weighed by a sensitive electronic scale.

**Average fruit size ($cm^3$):**

The average size of ten fruits used to measure the average weight of fruits was estimated by the displacement water method and using a graduated cylinder.

**Average yield per tree ($kg.tree^{-1}$):**

It was estimated by knowing the number of fruits remaining on the tree at harvest and the average weight of the fruit and by applying the following relationship:

**Percentage of grains in fruits (%):**

This percentage was estimated according to the following mathematical relationship, and then extracted as the arithmetic mean of the five fruits.

$$\textbf{Percentage of grains in fruits (\%)}=\frac{grain\ weight\ (g)}{Fruit\ Weight\ (gm)}\times 100$$

**Percentage of fruits drop (%):**

The number of fruits dropped on each tree of the experiment is calculated after the contract (the second week of June),Then the fruits were recalculated on the trees in the first week of October (the beginning of the commercial harvesting of the fruits of the cultivar Sala Khani in the region).

The percentage of fruits drop is then estimated by applying the following equation:

$$\text{Percentage of Fruits drop (\%)}=\frac{The\ number\ of\ set\ fruits-the\ number\ of\ fruits\ left}{number\ of\ set\ fruits}\times 100$$

**Results and discussion**

**Average fruit weight (g).**

It was found from the results of the statistical analysis in Table (8) that spraying with ascorbic acid had a significant effect on the average weight of the fruit.The use of spraying at a concentration of 750 $mg.L^{-1}$ of ascorbic acid excelled on the other treatments in the average weight of the fruit, as the highest average was 364.144 g. The reason for this may be due to the role of ascorbic acid in increasing the leaf area as well as the chlorophyll content of the leaves. As in Tables 3 and 5, which in turn leads to an

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improvement in the efficiency of the leaves to conduct the process of photosynthesis as well as its direct role in increasing the percentage of carbohydrates in the leaves (Fayed, 2010), which in turn increases the total soluble sugars in the leaves and the transfer of those sugars to the places where they are stored in the fruits, This leads to the growth of parts of the fruit and thus increases its weight. Where these results agree with (Daood and Shahin, 2006) in their study of the apricot trees of the Canino cultivar, and (Wassel et al., 2007) in their study of the grapevines of the Banati white cultivar, and (Fayed, 2010) in their study of the pomegranate trees of the Manfaluti cultivar, The use of salicylic acid did not have any significant effect on the average weight of the fruit. As for the bi-interaction between the two factors of the study,It was found that spraying with a concentration of 750 mg.$L^{-1}$of ascorbic acid combined with no spraying treatment with salicylic acid (368,867) g , on the interaction between 1500 mg.$L^{-1}$of ascorbic acid with 150 mg.$L^{-1}$of salicylic acid significantly excelled that gave the lowest average is 299.133 g.

**Table (8): Effect of spraying with ascorbic and salicylic acid on the average fruit weight (gm) of pomegranate cultivar Sala Khani**

| Salicylic acid concentration (mg.l-1) | Ascorbic acid concentration (mg.L-1) | | | salicylic acid average |
|---|---|---|---|---|
| | 0 | 750 | 1500 | |
| 0 | 328.000 abc | 368.867 a | 336.067 abc | 344.311 a |
| 75 | 326.067 bc | 365.133 ab | 361.000 ab | 350.733 a |
| 150 | 364.167 ab | 358.433 ab | 299.133 c | 340.578 a |
| Ascorbic acid average | 399.411 b | 364.144 a | 332.067 b | |

**The values that share the same letter within the same factor or their interactions have no significant differences between them according to Duncan's polynomial test at the 5% probability level.**

## Average fruit size ($cm^3$).

The results in Table (9) showed that spraying with ascorbic acid significantly reduced the average fruit size, as not spraying with ascorbic acid gave a larger fruit size of 269,000 cm3 compared to the lowest average volume of 267.444 $cm^3$ when treated with a concentration of 1500 mg.$L^{-1}$ of ascorbic acid While salicylic acid had no significant effect on the size of the fruit.As for the bi-interaction of the two study factors in the same table, it was found that the treatment of no spraying with ascorbic acid interaction with 150 mg.$L^{-1}$ of salicylic acid, which amounted to 324,000 $cm^3$, was significant in most of the other interaction treatments.While the lowest average was recorded when (750) mg.$L^{-1}$ of ascorbic acid interacted with 150 mg.$L^{-1}$ of salicylic acid.

## The average yield per tree (kg.$tree^{-1}$).

The results in Table (10) showed that spraying with ascorbic acid had no significant effect on the yield of the tree. While spraying with the second level (75 mg.$L^{-1}$) of salicylic acid gave the highest yield, reaching 69,577 kg.$tree^{-1}$ compared to the other treatments. The reason for this may be due to the role of salicylic acid in reducing the average fruit drop because it stimulates the action of auxins, gibberellins, and cytokinins, which in turn work to prevent the formation of the separation layer and thus reduce the average of fruits drop.As the yield of one tree has an inverse relationship with the percentage of fruits drop (Al-Khafaji, 2014) as in Table (6), which led to an increase in the average yield of one tree. These results agree with (Mokhtar et al., 2011) in their study on

 ISSN 2072-3875

apple trees.The results of the interaction between the two study factors in the same table showed that there were significant differences between the interactions, where the interaction between 1500 mg.L$^{-1}$ of ascorbic acid with 75 mg.L$^{-1}$ of salicylic acid gave the highest yield, which amounted to 72.179 kg.tree$^{-1}$ compared to the lowest percentage when compared the treatment of ascorbic and salicylic acids, which amounted to 48.903 kg.tree$^{-1}$.

**Table (9): Effect of spraying with ascorbic and salicylic acid on the average fruit size 3 cm for pomegranate Sala Khani cultivar .**

| Salicylic acid concentration (mg.l-1) | Ascorbic acid concentration (mg.L-1) | | | salicylic acid average |
|---|---|---|---|---|
| | 0 | 750 | 1500 | |
| 0 | 301.333 ab | 291.500 abc | 277.667 bc | 290.167 a |
| 75 | 262.667 bc | 288.667 abc | 270.000 bc | 273.778 a |
| 150 | 324.000 a | 246.333 c | 254.667 c | 275.000 a |
| Ascorbic acid average | 296.000 a | 275.500 ab | 267.444 b | |

**Table (10): Effect of spraying with ascorbic and salicylic acid on the average yield of one tree (kg.tree-1) for pomegranate Sala Khani cultivar.**

| Salicylic acid concentration (mg.l-1) | Ascorbic acid concentration (mg.L-1) | | | salicylic acid average |
|---|---|---|---|---|
| | 0 | 750 | 1500 | |
| 0 | 48.903 b | 49.751 b | 63.847 a | 54.167 b |
| 75 | 66.048 a | 70.505 a | 72.179 a | 69.577 a |
| 150 | 72.102 a | 52.495b | 52.781 b | 59.126 b |
| Ascorbic acid average | 62.351 a | 57.583 a | 62.935 a | |

**The percentage of grains in the fruits (%).**

It was found from the results of Table (11) that a nonsignificant effect was observed when spraying with ascorbic acid on the percentage of grains in the fruits. While spraying with salicylic acid reduced the percentage of grains in the fruit,As the treatment of not spraying with salicylic acid was recorded the highest percentage of grains amounted to 69.841%, which did not differ significantly from spraying with a concentration of 150 mg.L$^{-1}$, while the lowest percentage was 60.731% recorded when spraying with a concentration of 75 mg.L$^{-1}$.As for the effect of the interaction between the two factors, it was found that the non-spray treatment with ascorbic and salicylic acid gave the highest percentage of beads in the fruit was 73.932% compared to the lowest percentage (56.334%) when the interaction between 750 mg.L$^{-1}$ of ascorbic acid was concerned. With 75 mg.L$^{-1}$ of salicylic acid (Table 11).

 ISSN 2072-3875

**Table (11): Effect of spraying with ascorbic and salicylic acid on the percentage of grains in the fruits (%) of pomegranate Sala Khani cultivar.**

| Salicylic acid concentration (mg.l-1) | Ascorbic acid concentration (mg.L-1) | | | salicylic acid average |
|---|---|---|---|---|
| | 0 | 750 | 1500 | |
| 0 | 73.932 a | 68.269 ab | 67.324 ab | 69.841a |
| 75 | 62.529 ab | 56.334 b | 63.329 ab | 60.731 b |
| 150 | 67.213 ab | 62.737 ab | 62.943 ab | 64.298 ab |
| Ascorbic acid average | 67.891 a | 62.446 a | 64.532 a | |

**The percentage of fruits drop.**

The results in Table (6) that the use of ascorbic acid as a spray on the leaves had a negative impact on the percentage of fruit drop compared to the comparison treatment, which gave the lowest percentage of 2.726%. The reason for this is due to the role of ascorbic acid in regulating and activating some enzymes that act as a cofactor, especially the enzymes that make plant hormones such as ethylene (Gara, 2005), which in turn works to speed up the formation of the separation layer and thus raise the percentage of fruit drop. but the opposite happened when salicylic acid was used as a spray on the leaves. It caused a decrease in the fruit drop percentage by increasing the concentration used significantly, where the lowest percentage reached 2.854% recorded from trees sprayed with a concentration of 150 mg.$L^{-1}$ compared to the control treatment, which reached the highest percentage of 4.774 %.The reason for this is due to the role of salicylic acid in stimulating the action of growth stimulants, including auxins, gibberellins and cytokinins liberated from seeds, which reduce the percentage of fruits drop (Al-Khafaji, 2014). These results agree with (Ahmed et al., 2014) when studying mango trees and Aziz et al. (2017) in his study on pomegranate trees.The results showed that the bi-interaction between the two factors of the study in the same table was the interaction in the second level of ascorbic and salicylic acids, which recorded the lowest percentage (1.685%),While the highest dropping average was 7.407%, recorded when the interaction between spraying with a concentration of 750 mg.$L^{-1}$ of ascorbic acid and not spraying with salicylic acid.

**Table (6): Effect of spraying with ascorbic and salicylic acid on the percentage of fruits drop (%) of pomegranate Sala Khani cultivar .**

| Salicylic acid concentration (mg.l-1) | Ascorbic acid concentration (mg.L-1) | | | salicylic acid average |
|---|---|---|---|---|
| | 0 | 750 | 1500 | |
| 0 | 3.823 c | 7.407 a | 3.093 cd | 4.774 a |
| 75 | 2.183 de | 1.685 e | 6.153 b | 3.340 b |
| 150 | 2.171 de | 4.207 c | 2.185 de | 2.854 b |
| Ascorbic acid average | 2.726 b | 4.433 a | 3.810 a | |


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## Conclusions

The spraying with both concentrations of 750 and 1500 mg.l-1 of ascorbic acid improved and increased the quantitative traits and weight percentage compared to the control treatment.

## Recommendations

In light of the previous conclusions, we can make the following recommendations:

1. Using concentrations such as 750 $mg.L^{-1}$ of ascorbic acid and 75 $mg.L^{-1}$ of salicylic acid are the most effective in improving the quantitative growth of trees.

2. We recommend the use of salicylic acid for the purpose of reducing the fruits drop.

3. Study of the effect of spraying ascorbic and salicylic acid on other pomegranate cultivars.

4. Using spraying with some plant extracts because they are safe for health and the environment and are rich in hormones, amino acids, organic, and nutrients.

5. Conducting some studies for the purpose of reducing physiological diseases in the fruits, especially the incomplete discoloration of the grain and the cirrhosis of grain that have recently appeared in the region.

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