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Improving the Productivity of Zaghinia Apricot Trees by Foliar Application of Sitofex and L-Arginine

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Abstract:

This study was carried out on six years old apricot trees Zaghiniacultivar, in the Agricultural Research and Experiments Station of the Faculty of Agriculture-University of Kirkuk during the 2020 growing season. This is to demonstrate the impact of spraying threeconcentrations of Sitofex growth regulator (0, 7.5 and 15 mg L^{-1}) and three concentrations of the amino acid Arginine (0, 250 and 500 mg L^{-1}) in some of the yield characteristics and its physical and chemical components.

The results pointed out that spraying with Sitofex and Arginine and the interaction between them had a significant effect on most of the studied characteristics, as the concentration 15 mg. L^{-1} of Sitofexexceeded in the characteristics: fruit set, fruit weight, fruit firmness, fruit size, TSS, and TSS / TA ratio), and the hectare yield with a percentage of (16.23%,26.74 g, 2.14 kg $cm^{2\ -1}$, 35.51 cm^2, 13.34%, 12.23, 5.26 t ha^{-1}) While, no coefficients were shown Sitofex had no significant effect on the characteristic of carotene and total acidity. As for arginine, the treatment at a concentration of 500 mg. L^{-1} outperformed the rest of the treatments in the characteristic of carotene ratio, TSS, TSS / acidity ratio, the yield of hectare, and the combination showed 15 mg. $^{-1}$ of Sitofex and 500 mg.L^{-1} arginine had a significant effect in most of the studied characteristics.

key words: sitofex, arginine, Foliar application, and Apricot (*Prunus armeniaca* L)

Introduction:

Apricots are a temperate deciduous fruit with a stone core. It is descendent to the family of Rosaceae (Osman et al., 2010). Apricot trees were known more than 5000 years ago in China, where they were attributed to the reign of Emperor YU, and that the English name for apricots is derived from the Greek apricot name AL-Praecox, which means early fruit (Janick, 2005). The production of apricots for the summer season 2019 in Iraq is estimated at (34728) tons, and the average productivity of one tree is estimated at (32.56) kg. Salah al-Din Governorate

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ranked first, followed by Baghdad Governorate, and then Nineveh Governorate in the rank (Central Organization for Statistics and Information Technology, 2019)

In general, the apricot classes are among the fruit trees with a short growing season and rarely suffer from the phenomenon of exchange of pregnancy. Therefore, they bloom annually and bear relatively large quantities of flowers and fruits, especially in the self-fertile varieties, which in turn lead to increased flowering and fruit loss after setting fruit and before the harvesting in particular, as well as the poor quality (Ibrahim, 1998). All of these represent problems for the farmer, the producer and the consumer alike, due to the lack of studies on the cultivated varieties in Kirkuk and the surrounding areas, problems of fruit loss, low quality characteristics and small size of fruits which are problems facing the apricot producers there. We have decided to experiment with treating these problems by using the growth regulator Sitofex, the amino acid arginine, and the interference spray on the leaves and flowers of the apricot variety Zaginia.

In recent years, the world paid attention on the use of many growth regulators, including cytokinins, which are used in the field of horticulture in order to improve the vegetative, quality and production characteristics of fruit trees in particular (Al-Shahat, 2000 and Al-Khafaji, 2014). Cytokinins play an important role in many physiological processes associated with the growth and development of plants. They affect the processes of cell division and callus formation in tissue culture, and they stimulate protein production in particular and participate in controlling the cell cycle. Perhaps, this makes them affect the formation and attainment of green plastids in addition to delay aging of separated leaves and helps prevent flowering of organs during the pollination process, fertilization or fruit set, including Sitofex, which is one of the names of commercial products for industrial cytokines CPPU (WOZNY, 1975)

Pant (2015) showed that spraying Red Delicious apple trees at the age of 15 years during the 2014 season with Sitofex at a concentration (2.5, 5, 7.5 and 10 mg L^{-1}) significantly increased the fruit set character, number of fruits, fruit weight, and tree yield by increasing the spray concentration compared to the non-sprayed trees. The treatment gave 10 mg / liter $^{-1}$ the best results. Ennab and Abo-Ogiela (2019) studied the effect of spraying Sitofex with four levels 0, 5, 10, and 15 mg L^{-1} on plum trees (pears) of the Kelsey category grafted onto an 8-year-old Mariana type.During the 2018--2019 seasons, noticed that there was a significant increase in the size of fruits at the level of 15 mg liter^{-1}, and on the contrary, the control treatment was superior in the percentage of total soluble solids, acidity and the ratio of TA / TSS.Amino acids play an important role in many vital processes, as amino acid is the basic unit in the formation of proteins and peptides and is considered a bio-stimulant that absorbs and moves quickly within the various parts

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of the plant. The amino acid arginine is one of the most important amino acids that help plants resist difficult conditions and stress, such as low and high temperatures, salinity, water stress, and blackening aeration in the soil, has a role in the formation of chlorophyll and is considered as the initiator of the formation of polyamines and promotes the formation of roots and cell division (Aberg, 1961 and YangandGao 2007).

Fayek et al. (2011) found that when they sprayed the amino acid arginine on pear trees, it was cultivated to be 12 years old during the 2008-2009 study seasons and with two levels (500 and 1000 mg L^{-1}), where the treatment exceeded 1000 mg L-1 in the characteristic of the final decades by an increase (19.4 and 62.16), and in the tree yield, an increase of 102% -114%. Arabloo et al. (2017) showed that when spraying amino acids on two varieties of apples with three levels 0, 2 and 4 mg liter -1, the presence of significant differences in the average weight of the fruit in the above two varieties, the treatment of 4 mg L^{-1}outperformed the rest of the other treatments. Whereas the treatment 2 mg liter -1 in the hardness characteristic of the two types above also exceeded the comparison treatment and the same treatment outperformed the TSS characteristic for the variety as a child, while the treatment 4 mg L^{-1}gave the lowest pH ratios.

Materials and work methods

The study was carried out during the 2020 growing season in the deciduous fruit orchard- Agricultural Research Station- College of Agriculture - University of Kirkuk to study the effect of spraying with threeconcentrations of Sitofex (0, 7.5 and 15 mg L^{-1}), and three concentrations of amino acid Arginine (0, 250 and 500 mgL^{-1}) in some characteristics of the yield and its physical and chemical components for apricot trees, Zaghinia cultivar that six years old, which were planted in a rectangular system at a distance of 5 * 4 m. Soil samples were taken at a depth of 60 cm from different parts of the field before starting the experiment to identify some of the physical and chemical characteristics of the soil, as shown in Table 1).

The trees were irrigated by drip irrigation system, and the selected trees were as homogeneous as possible in their growth strength and size.

The foliar spray of Sitofex and Arginine were done three times,the first was given a week after full bloom on 7/3/2020, followed by two times with three weeks interval. Classical agricultural practices were conducted whenever needed, including hoeing, pruning, disease and insect control, organic fertilization (buffalo waste) and mineral fertilization during the study season on all experiment treatments equally.

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The treatments were distributed randomly to trees in a two-factor experiment. Randomized Complete Block Design (RCBD) was applied in three replicates, with one tree per experimental unit. The probability level is 5% and the ready-made program SAS (2001) was used to statistical analysis of data.

Table 1. Physical and chemical characters of experimental orchard soil.

Adjective	Quantity	measuring unit	Adjective	Quantity	measuring unit	Adjective	Quantity	measuring unit
PH	7.60	-	**K**	1.60	mg.Kg-1	**Clay%**	3	%
EC	1.125	Mmho.cm2	**Mg**	1.67	mg.L. -1	**Silt%**	41	%
N	0.83	%	**Ca**	4.83	mg.L. -1	**Sand%**	56	%
P	0.47	%	**Organic matter**	0.54	%	**Texture**	Sandy loam	

The studied measurements:

First: Fruit set, yield and physical characteristics of fruits:

1. Fruit set (%): was calculated according to the following equation. (Number of setting flowers / total number x 100).

2. Fruit weight (gm): According to the average weight of the fruit when the fruits are ripening on 5/15/2020 with a weight of (10) fruits from each experimental unit using a sensitive electrical balance, then the average weight of the fruit is extracted as an estimate in grams

3. Fruit volume (cm^3): Fruit size was calculated using the water-displacement method from the inserted glass cylinder.

4. Fruit'sfirmness (kg cm^2): The hardness of fruits is measured with a Pentometer

5. The yield (tons hectar-^{1}): The yield was calculated by the yield of one tree and the number of trees per unit area, depending on the distances of cultivation.

Second: The chemical fruit characteristics:

1. Carotene (%): the carotene percentage in fruit peel was determined according to the method mentioned by Goodwin (1976).

2. TSS%: The percentage of total dissolved solids in fruits was measured by using the electronic MA871 Refractometer device.

3. Total acidity (TA) (%): It was calculated according to the method mentioned in A.O.A.C, 1970).

4. TSS / TA Ratio.

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RESULTS AND DISCUSSION:

The results of Table (2) indicate that spraying apricot trees with Sitofex at a concentration of 15 mg. L^{-1} led to a significant increase in the traits (fruit setting, fruit weight, hardness, fruit size and hectare yield) with an increase of (56.51, 14.52, 7.54, etc.) (4.47, 213.09)%, respectively, compared to the comparison. Likewise, the treatment with a concentration of 500 mg. L-1 of arginine outperformed the rest of the treatments in the characteristic of the hectare yield by an increase of 10.24%. The hardness of the fruits, as the comparison treatment outperformed the rest of the treatments with a rate of 2.22 kg. Cm^2-1.

As for the bilateral interaction between the levels of Sitofex and arginine, it was also shown from Table (2) that the concentration was higher than 15 mg. L^{-1} of Sitofex interfering with the concentrations (0, 250 and 500) mg. L-1 of arginine significantly. The rest of the transactions in each of the characteristics (fruit setting, fruit size, and hectare yield) were (16.14, 16.25, 16.30)%, respectively, for fruit setting and (35.50, 35.50, 35.54) cm 3, respectively, for fruit size and (5.02, (5.32 and 5.43) tons. Ha-1, respectively, for the yield per hectare, and the concentration exceeded 15 mg. L^{-1} of Sitofex interfered with concentrations (0 and 250) mg. L^{-1} of arginine significantly over the rest of the treatments for the weight characteristic. The fruit, if it reached (27.00 and 27.26) gm, respectively, while the bilateral overlap between the levels of Sitofex and arginine did not show any clear significant effect on the fruit hardness characteristic.

Table 2. Effect of foliar application with Sitofex and Arginineon yield and some physical fruit characteristics of " Zaghinia " apricot trees

Sitofex (mg L^{-1})	Arginine (mg L^{-1})	characteristics				
		Fruit set (%)	Fruit weight (g)	Yield (t ha^{-1})	Fruit volume (cm3)	Fruit firmness (kg/cm^{2-1})
0	0	7.86 c	22.97 d	1.53 d	33.95 c	2.24 a
	250	11.43 b	23.82 d	1.71 d	34.00 c	2.00 bcd
	500	11.82 b	23.27 d	1.81 cd	34.01 c	1.74 e
7.5	0	13.17 ab	25.30 bc	2.23 bc	34.80 b	2.12 b
	250	13.27 ab	25.47 bc	2.25 bc	34.82 b	1.97 cd
	500	13.68 ab	25.00 c	2.46 b	34.87 b	1.88 d

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15	0	16.14 a	27.00 a	5.02 a	35.50 a	2.29 a
	250	16.25 a	27.26 a	5.32 a	35.50 a	2.10 b
	500	16.30 a	25.97 b	5.43 a	35.54 a	2.04 bc
Sitofex (mg L^{-1})	0	10.37 c	23.35 c	1.68 c	33.99 c	1.99 b
	7.5	13.37 b	25.26 b	2.32 b	34.83 b	1.99 b
	15	16.23 a	26.74 a	5.26 a	35.51 a	2.14 a
Arginine (mg L^{-1})	0	12.39 a	25.09 ab	2.93 b	34.75 a	2.22 a
	250	13.65 a	25.51 a	3.09 b	34.79 a	2.02 b
	500	13.93 a	24.74 b	3.23 a	34.79 a	1.89 c

Means not sharing the same letter (s) within each column for each are Significantly different at0.05 level of probability

The results showed in Table (3) that the percentage of total dissolved solids and the percentage of TSS / acidity were significantly increased in fruits when spraying with a concentration of 15 mg. L-1 of Sitofex, by 13.34% and 12.23, respectively.While spraying apricot trees with Sitofex did not show any significant effect on the total acidity characteristic, and the results showed that the carotene percentage was not significantly affected when the trees were sprayed with Sitofex, as the comparison treatment outperformed the rest of the treatments, as it reached 0.071 mg 100 ml -1.The results of Table (3) showed that the percentage of carotene and the ratio of TSS / acidity were significantly increased in fruits when spraying with a concentration of 500 mg. L^{-1} of arginine and by a percentage of 0.073 mg, 100 ml-1 and 12.46, respectively. The spray with two concentrations 250 and 500 mg. L^{-1} of arginine significantly outperformed the comparison treatment in the percentage of total dissolved solids and reached (12.82 and 12.94%) respectively, and they did not differ significantly between them. Total acidity, as the comparison treatment outperformed the rest of the transactions and reached 1.18%, an increase of 13.46%.

As for the two-way interaction between the levels of Sitofex and arginine, the treatment with a concentration of 0 mg. Liter-1 of Sitofex interfered with a concentration of 500 mg. Liter-1 of arginine had a significant effect on the characteristic of the carotene ratio with a percentage of 0.083 and the results showed that the treatment at a concentration of 15 mg. -1 of Sitofex interfering with concentrations (0, 250 and 500) mg $L^{-1}$of arginine had a significant effect on the characteristic of TSS, reaching (13.33, 13.35, 13.36)%, respectively, compared to the rest of the other treatments. The results showed that all the double

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interference coefficients outperformed the control treatment in the characteristic of TSS / acidity. As for the bilateral interaction between the levels of Sitofex and arginine, they did not show any significant effect on the total acidity characteristic.

Table 3. Effect of foliar application with Sitofex and Arginine on chemical fruit characteristics of " Zaghinia " apricot trees

Sitofex (mg L^{-1})	Arginine (mg L^{-1})	characteristics			
		Carotene (mg/100g)	TSS %	TA %	TSS/TA
0	0	0.057 d	11.99 c	1.21 a	9.90 d
	250	0.073 b	12.55 b	1.09 bcd	11.48 abc
	500	0.083a	12.65 b	1.00 d	12.74 a
7.5	0	0.067 bc	12.43 b	1.19 ab	10.42 cd
	250	0.060 cd	12.57 b	1.14 abc	11.00 bcd
	500	0.067 cb	12.81 b	1.06 cd	12.70 ab
15	0	0.060 cd	13.33 a	1.13 abc	11.79 abc
	250	0.067 cb	13.35 a	1.08 cd	12.37 ab
	500	0.070 b	13.36 a	1.06 cd	12.55 a
Sitofex (mg L^{-1})	0	0.071 a	12.40 b	1.10 a	11.39 b
	7.5	4 b0.06	12.60 b	1.13 a	11.16 b
	15	b0.066	13.34 a	1.10 a	12.23 a
Arginine (mg L^{-1})	0	0.061 c	12.59 b	1.18 a	10.71 c
	250	0.067 b	12.82 a	1.11 b	11.62 b
	500	0.073a	12.94 a	1.04 c	12.46 a

Means not sharing the same letter (s) within each column for each are Significantly different at0.05 level of probability

Discussion:

The increase in most of the physical characteristics of the fruits, which is obtained as a result of spraying Sitofex, may be attributed to its effect on the processes of cell division and accidental elongation. It delays the plant tissue into

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aging by inhibiting the special enzyme activity as well as reducing the enzyme activity, whose percentage increases when the plant organ becomes aging, as well as preventing or reducing the loss of leaves, flowers and fruits for its positive effect on the plant, preserving the green matter chlorophyll and preventing its degradation and has an active role in the ovarian growth process in the early stages and its transformation into fruit.It also has an important role in increasing the surface area of the leaves by increasing the size of the chloroplasts and then increasing the protein build-up and increasing the number inside them. Thus,it leads to increasing the photosynthesis of the plant and the enzymes responsible for it as well (Hunt, 1982 and Shoukat, 2007). It works to increase the process of transpiration by increasing the opening of the stomata by an amount that may reach 50%, which leads to an increase in the absorption of water and nutrients and has an important role in increasing the accumulation of RNA and enzymes necessary to build nucleic acids, and these results are in agreement with Khalil (2020) and Sahu and Sharma (2019).

The physiological response can be explained by treatment with amino acid (arginine), as arginine plays an important role in many biological processes, whether in a free form or one of the protein components, as amino acids, including arginine are considered to be the building blocks of proteins that perform multiple tasks within the plant, including regulating metabolic processes, transportation and storage of nitrogen. The reason may also be attributed to the direct and indirect effect of amino acids in stimulating biological processes inside the plant, including increasing the efficiency of the photosynthesis process, converting the products of this process into complex materials and also increasing carbohydrates (Fowden, 1973 and Yang, 2007). Arginine is also the initiator of polyamines and has a role in many physiological processes, including cell division, growth, increase in size, flowering and fruit development, and it works to increase the levels of some hormones within plants, including oxygen and gibberellin (Mansour, 2000 and Thomas, 2009). These results are consistent with those reported by Viorica (2017) and Ali (2019).

It is concluded from this study that the results showed that spraying (Sitofex) and (Arginine) alone or in combination with each other improved the yield characteristics (fruit setting, weight, and hectare yield) and the physical and chemical characteristics of the fruits and the superiority of spraying Sitofex treatment with a concentration of 15 mg L^{-1}. The amino acid L-1 and the amino acid L-arginine at a concentration of 500 mg L^{-1} were either single or overlapping in most of the study characteristics.

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