



EFFECT OF NANO IRON AND SALICYLIC ACID SPRAY ON STRAW BERRY PLANTS GROWTH AND PRODUCTIVITY

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Article history:	Abstract:
Received: 8 th August 2023 Accepted: 7 th September 2023 Published: 10 th October 2023	<p>A factorial experiment was carried out in a plastic house at the nursery of the Horticulture Division in the Plant Production Department, Directorate of Agriculture in Diyala Governorate during the 2020-2021 growing season., aiming to study the effect of spraying strawberry plant Camarossa variety with Nano iron and salicylic acid. The experiment was conducted using RCBD, with three replication, and two factors, the first was Nano iron at three concentrations (0,10,20 mg L⁻¹), and the second was salicylic acid at three concentrations also (0,100,200 mg.L⁻¹). Means were compared using Duncan's multiple range test 0.05 probability level. Results can be summarized as follows: Nano-Fe sprays at 20 mg L⁻¹ significantly improve the vegetative and fruiting characteristics. It gave the highest leaf area, leaves N, P content(%), number of fruits per plant, the highest fruit weight, and the highest TSS content(%) in fruit juice compared to the untreated control.</p> <p>Salicylic acid spray at 200 mgL⁻¹ gave the best results in leaves' Nitrogen content(%), total leaf area, and mean fruit weight compared to untreated one, on the other hand, the salicylic acid spray did not significantly affect the leaves' P content, total number of fruits, and total soluble solids.</p>
Keywords: Salicylic Acid. Nano Iron. Camarosa, Strawberry.	

INTRODUCTION

Strawberry is one of the most important small fruit plants that are widespread in the world, it includes about 45 species, including wild, and cultivated strawberries 1. strawberry plants grow in a wide range of environmental conditions, where its cultivation extended through more than 76 countries, with a global production of about 8.9 million tons annually, 2.

Strawberry is consumed as a fresh fruit and has a high nutritional value due to the fact that it contains many compounds, as every 100 grams of fresh fruit contains 90% water, 32% kilocalories of energy, 7.7g of carbohydrates, 4.9g of sugars, 2g of fiber, 0.67g of protein and 0.3g of protein. Fats, while its mineral content is 153 mg of potassium, 24 mg of phosphorus, 16 mg of calcium, and 13 mg of magnesium, and also has many vitamins, including 58.8 mg of vitamin C and 0.39 mg of niacin 3. Strawberry fruits have numerous medical benefits due to their positive effects on human health, 4 because they contain polyphenols, which help in protecting people from many diseases, including heart disease, cases of atherosclerosis, blood vessels, neurological disorders, type 2 diabetes, and obesity, as well as Cancerous diseases 5.

Although the climatic conditions are suitable for the cultivation of strawberries in Iraq, it is believed that its cultivation was introduced to Iraq accidentally into home gardens during 1946-1951(1), The alkaline nature of Iraqi soil limited the availability of many micronutrients for plant roots, including iron, which is an essential element for plant growth, chlorophyll synthesis, respiration, and redox processes within plant tissues. It is also involved in the synthesis of important cytokines in plants, in addition to the important role in photosynthesis. (6).

Nanotechnology enhances the uptake of nutrients and nutrients with high efficiency due to the free passage from the Nano-sized pores and through carriers leading to an increase in the uptake of nutrients inside the plant and the nanoparticles may pass through the plasmodesmata leading to the effective movement of nutrients. Nano-fertilizers can achieve the fastest response of plants, especially with the existing problems in the soil, such as high PH, unavailability of nutrient ions for the plant, and the lack of efficient root growth (2).

Salicylic acid is one of the naturally occurring plant hormones with a phenolic group. This compound affects the growth, flowering, and absorption of ions in plants. It accelerates the formation of chlorophyll and carotene pigments (8), regulating stomata closure, accelerating, and increasing the activity of a group of important enzymes, and gains systemic

immunity from pathogens. In addition, salicylic acid plays an important role in regulating the response of plants to environmental stress conditions (9).

This study was conducted aiming to reveal the role of Nano-Fe and salicylic acid spray in improving strawberry plants' growth and productivity under local conditions.

MATERIALS AND METHODS

A factorial experiment was carried out in a plastic house during the 2020-2021 growing season. The experiment included two factors, the first one was three levels of Nano-iron (0,10,20 mg L⁻¹). The second was three levels of salicylic acid (0,100,200 mgL⁻¹). transplants were planted on 1/11/2020 on terraces(40*30 cm) using a drip irrigation system(two irrigation lines per terrace). Treatments were distributed according to the RCBD regime, with 9 treatments per block, and eight plants per experimental unit. Results were analyzed using the SAS (2003) statistical program. Treatments means were compared according to Duncan's multiple range test at a probability level of 0.05, and the following traits were measured:

1. Total leaves area: (dm²)

2. Leaves Nitrogen content: (%):

Determined using a spectrophotometer according to the method mentioned by 10 .

3. Phosphorus: (%)

Leaves phosphorus content was determined using ammonium molybdate and ascorbic acid and measured by a spectrophotometer at 882 nm wavelength according to(11).

4. Number of fruits per plant:

5. Fruit weight: (g)

6. Total soluble solids (TSS): (%)

TSS was determined using a hand refractometer. Ten homogeneous ripe fruits from each experimental unit were cut into slices and placed in an electric mixer for 2-3 minutes, after that the juice was filtered with a cotton cloth, and the reading was taken to represent TSS in the fruit juice.

RESULTS AND DISCUSSION

Results in Tables1, and 2 show that Nano-iron spray at 20 mgL⁻¹ significantly superior in growth and yield characteristics, it gave the highest values in leaves area(14.96 ds), N content(1.557%), and P content (0.191%), furthermore it gave the highest number of fruits per plant(52.90 fruit Plant⁻¹), fruit weight (23.77 g), and TSS in fruit juice (7.796%), compared with untreated plants.

The best results achieved in Nano- Fe treatments may be due to its small size partid that increasing the surface area, which increases the absorption surface, and the possibility of direct entry into plant cells(12), Iron is an essential element in chlorophyll molecules that 3-29 % of the total amount of iron in plants founded in green leaves , furthermore Fe plays an important role the structure of enzymes and compounds that build up the chlorophyll molecule 13 Which enhance vegetative growth through increasing cell division, and cell elongation, and as a result it improve nutritional and fruiting state in plants.. This is in line with 14) and 15. on plants.

Salicylic acid spray at 200 mgL⁻¹ caused a significant increase in total leaves area(11.56 dm⁻²), laves N content (1.258%), and mean fruit weight(20.45 g), compared with untreated one.

The positive effects resulted from SA application may be due to the regulatory role of this growth regulator in the physiological operations, as it works to accelerate the construction of chlorophyll pigments and carotene, which resulted in the acceleration of photosynthesis, and increasing the activity of some important enzymes (9). These results is in agree with the results obtained by (16), 17, and 18)

The interaction between nano-iron at 20 mg L⁻¹ and salicylic acid at 200 mg L⁻¹ gave the highest values for total leaves area (17.32dm⁻²), leaves nitrogen content (1.193%), P content(0.193%), and No. of fruits per plant (52.97 fruit). Mean fruit weight(24.00 gm), and the percentage of total soluble solids in fruit juice (7.980%), compared with untreated control.

Table: 1. Effect of nano iron and salicylic acid spray on the total leaves area, Nitrogen, and phosphorus content(%) in strawberry leaves

Treatments		Total leaves area (dm ⁻²)	N (%)	P (%)
Nano iron (Fe)	0	5.457 C	0.833 B	0.179 B
	10	9.576 B	1.160 B	0.186 AB
	20	14.96 A	1.557 A	0.191 A
Salicylic acid (S)	0	8.715 B	1.114 A	0.184 A
	100	9.717	1.178	0.183

			B	A	A
	200		11.56 A	1.258 A	0.189 A
Nano iron (Fe) * Salicylic acid (S)	Fe1	S1	4.347 f	0.823 b	0.177 a
		S2	4.946 de	0.853 b	0.179 a
		S3	7.079 e	0.823 b	0.181 a
	Fe2	S1	9.357 d	1.273 b	0.186 a
		S2	9.081 ed	1.190 b	0.182 a
		S3	10.29 dd	1.017 b	0.191 a
	Fe3	S1	12.44 c	1.247 b	0.190 a
		S2	15.13 b	1.490 ab	0.189 a
		S3	17.32 a	1.933 a	0.193 a

Means with the same letter didn't differ significantly according to Duncan's multiple ranges test at 0.05 level

Table: 2. Effect of nano iron and salicylic acid spray on the number of fruits per plant, mean fruit weight, and total soluble solids in strawberry fruits

Treatments		No. fruits Per plant	fruit weight (g)	TSS (%)	
Nano iron (Fe)	0	45.22 B	14.41 C	7.102 C	
	10	47.74 B	22.35 B	7.391 B	
	20	52.90 A	23.39 A	7.796 A	
Salicylic acid (s)	0	47.80 A	19.77 C	7.379 A	
	100	49.20 A	19.93 B	7.426 A	
	200	48.86 A	20.45 A	7.486 A	
Nano iron (Fe) * Salicylic acid (S)	Fe1	S1	45.13 b	14.18 g	7.053 d
		S2	45.99 b	14.39 g	7.060 d
		S3	44.54 b	14.66 f	7.193 cd
	Fe2	S1	45.71 b	22.20 e	7.380 c
		S2	48.45 ab	22.17 e	7.417 c
		S3	49.06 ab	22.67 d	7.377 c
	Fe3	S1	52.58 a	22.93 c	7.703 b
		S2	53.16 a	23.24 b	7.707 b
		S3	52.97 a	24.00 a	7.980 a

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