Foliar application of Copper and Iron on Chemical Indicators of Strawberry Seedlings (Fragaria Ananassa) Grown in Non-Air-Conditioned Greenhouses in AL-Najaf Governorate.

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Abstract

The study was conducted in a non-air-conditioned plastic house located in the nursery of the Horticulture and Forestry/ Department of Plant Production / Al-Najaf Agriculture Directorate. The study was observed from (1/11/2021) to (1/6/2022). Randomized Complete Block Design (RCBD) was adopted as a factorial experiment (3*3) with three replications in each treatment. The first studied factor was three concentrations of Iron that were 0, 50, and 75 mg.L-1 while the second factor was three concentrations of copper (H2O5.CuSO4) that were (0,5, and 10) mg.L-1. The interactions between the factors were also studied. The study included 27 experimental units, every experimental unit has 10 plants within. The means of the properties were analyzed using the Genstat statistical analysis program. Dunkin's multiple range test at the probability level 0.05 was used to compare the means.

The most important results can be summarized as follows:

-1 Foliar application of iron at a concentration of 75 mg.L-1 increased the characteristics of leaf content of total chlorophyll, carbohydrate content in leaves, total sugar in the fruit, the leaf content of protein, and the leaf content of nitrogen. These were superior to record 10.15 mg.100 g fresh weight-1, 13.4 mg.g dry weight-1, 15.4 g.100 g fresh weight-1, 7.04%, and 2.61% compared to the control treatment which gave the lowest value of 5.87 mg.100 g fresh weight-1, 8.4 mg.g dry weight-1, 13.7 g.100 g fresh weight-1, 6.87%, and 2.41% respectively.

-2 Foliar application of copper at a concentration of 10 mg.L-1 increased the characteristics of leaf content of total chlorophyll, carbohydrate content in leaves, total sugar in the fruit, the leaf content of protein, and the leaf content of nitrogen. these scord10.15 mg.100 g fresh weight-1, 13.4 mg.g dry weight-1, 15.4 g.100 g fresh weight-1, 7.04%, and 2.61% compared to the control treatment which gave the lowest value of 5.87 mg.100 g fresh weight-1, 8.4 mg.g dry weight-1, 13.7 g.100 g fresh weight-1, 6.87%, and 2.41% respectively.

Keyword: Copper, Iron, Strawberry, foliar application

Introduction

Strawberry Fragaria X ananassa Duch, which belongs to the Rosaceae family, is one of the small fruit plants. Strawberry called Chilik in Iraq which came from its name in Turkey. It includes more than 150 species that are difficult to distinguish and separate between.

ISSN 2072-3857

North America is believed to be the original home[1.[

The cultivation of the strawberry plant in Iraq was introduced to home gardens between 1926-1951. The first cultivation was in the Singar area in Sulaymaniyah Governorate, which is located at an altitude of 900 m above sea level. From there, its cultivation spread to throughout the country [2[.(Al-Saeedi, 2000). As for its cultivation in Najaf Governorate, the first field of strawberry plants was planted in 2009, with a total area of one acre in the Abbasiya district. Strawberries were planted in the nursery of the Agriculture Directorate in the governorate in the same year, with two plastic houses. The varieties that were planted was Festival, Sweet Charlie, and Ruby Gem [3.[

Iron is an essential element for plants. It plays a fundamental and essential role in regulating of many enzymes that are involved in the respiration process, including Catalase, Ferredoxin, Peroxidase, and Cytochrome oxidase. The participation of iron in these compounds is important in oxidation reactions, as it transfers electrons in oxidation and reduction reactions, and it is one of the important roles in the cell's metabolic processes [4.[

Copper is considered one of the necessary micronutrients for plant growth. It plays a major role in many of the plant's processes, including the synthesis of protein and carbohydrate formation. It also plays a role in the process of photosynthesis since it contributes in building chlorophyll through a high percentage of total copper presented in chloroplasts. It participates in the composition of some enzymes such as Ascorbic acid oxidase, Cytochrome oxidase, and the electron transport chain that links the two photochemical reaction systems of photosynthesis [5.[

This work aims to study the chemical properties of strawberry plants under different concentrations of Iron and Copper. It also aims to provide all the necessary conditions and requirements to increase the planted area in Najaf Governorate as well as other Iraqi governorates .

Materials and Methods

The experiment was carried out in one of the non-air-conditioned plastic houses of the Nursery of the Horticulture and Forestry / Plant Production Department /Al-Najaf Agriculture from (1/11/2021) to (1/6/2022). The Ruby Gim variety was imported from Turkey and then the stem was prepared to be transferred and planted in the greenhouse soil. The plastic house was weeded, plowed, and smoothed. Manual weeding, hoeing and pest control were carried out in all treatments whenever necessary. Guard lines for strawberry seedlings were placed on both sides of the house, parallel to the first and last lines of the experimental units. A fan ventilation system was implemented. The soil of the plastic house was divided into trays of 0.80 m width, 0.30 m height, and 26 m length. Half a meter at the beginning and end of the plastic house was planted with the same variety but it was put out of the data collection. The drip irrigation system was followed with a drainage rate between 3.5-4 liters.h-1 whenever needed. In addition, the fertilization operations are carried out uniformly for all treatments according to the fertilizer program approved in most strawberry farms. The soil was analyzed in the laboratory of the Al-Najaf Agriculture Directorate to measure the physical and chemical properties, and the results were as shown in Table (1.(

ISSN 2072-3857

Table (1) Physical and chemical analysis of the soil

Property		value	measuring unit
Soil articulations	sand	380	gm.kg $^{-1}$
	silt	308	
	clay	312	
Texture	clay loam		----
pH	7.4		
EC electrical conductivity	1.7		Decismens. M^{-1}
CO3	Nil		
N nitrogen	0.261		PPm
P.P	0.245		PPm
K potassium	92.2		PPm
Calcium Ca	4		mmol.L^{-1}
Magnesium Mg	9.6		mmol.L^{-1}
Iron Fe	0.88		mmol.L^{-1}
Cl chloride	5		mmol.L^{-1}
HCO3	0.7		mmol.L^{-1}
SO4	0.42		mmol.L^{-1}

Transactional procedure and experimental design

The study is carried out according to the Randomized Complete Block Design (RCBD) in a factorial experiment (3 * 3) with three replications. The first factor was three concentrations of Iron that are (0,50, and 50) mg.L-1while the second factor was three concentrations of copper (H2O5. CuSO4) that are (0,5, and 10) mg.L-1. The interactions between the factors were studied. The experiment includes 27 experimental units, each unit includes 10 plants. Genstat statistical program is used to analyze the data.

Studied indicators

Five plants were taken from each experimental unit for the measurement

-1Total chlorophyll pigment of leaves (mg.100 g fresh weight-1(

A sample of fully expanded leaves from each treatment weighing 0.5 g was taken and placed in the ceramic flask. Then (10) ml of 80% acetone was added and crushed until the tissue became white. The mixture was filtered to separate the dye solution from the leaf tissue using Whatman No. 1 filter paper. The filtrate solution resulting from the two filtration processes was collected and the volume was completed to (15) ml using acetone and was read using a spectrophotometer. Light absorption readings were taken at two wavelengths, 645 and 663 nm[6]. Then the total amount of chlorophyll was calculated in units of (mg.100 g fresh weight-1) by applying the following equation:

Total chlorophyll=20.2 x D(645) +8.02 x D(663)(V/W x1000) x 100

-2Measuring carbohydrates in leaves (mg. g dry weight-1(

Carbohydrates were estimated by taking 10 mg dry weight of plant leaves and adding 5% sulfuric acid H2SO4 at a concentration of 80% and 1 ml phenol at a concentration of 5%. The mixtures were left for ten minutes until they

ISSN 2072-3857

turned orange, which indicated the reaction response. Then the transparency was measured at a wavelength of 490 nanometers using a UV-visible spectrophotometer[7.[

-3Total sugar content of fruits (g. 100 g fresh weight-1(

Measured by Digital Refract meter model DR201-95 manufactured by Kruss German company [8.[

-4Protein content of leaves(%)

The percentage of proteins in the leaves of strawberry seedlings was calculated according to the following equation:

Protein % = Nitrogen % × 6.25 [9.[

-5Nitrogen content of leaves(%)

The fourth and fifth leaves were taken from each branch in the experimental unit and dried in an electric oven at 65°C until the weight was constant. Then leaves were ground, and 0.2 g of the ground plant samples were taken. The samples were digested by adding 4 ml of concentrated sulfuric acid and 2 ml of concentrated perchloric acid, then nitrogen was estimated using the (Kjeldahl) device.

Rustles:

1-3Effect of spraying iron and copper elements and their interaction on the chemical indicators of the Shalik plant, variety (Ruby Gim(

Plants treated with Iron at the concentration of (75 mg. L-1) were significantly superior Table (2). It gave the highest value for the studied parameters including leaf content of total chlorophyll, carbohydrate content in leaves, total sugar in the fruit, protein content, and nitrogen. It recorded 10.15 mg. 100 g fresh weight-1, 13.4 mg. 100 g dry weight-1, 15.4 g. 100 g fresh weight-1, 7.04%, 2.61% compared to the control treatment which gave the lowest value of 5.87 mg. 100 g fresh weight-1, 8.4 mg. 100 g dry weight-1, 13.7 g. 100 g fresh weight-1, 6.87%, 2.41% respectively .

The same table shows the superiority of copper at the concentration of 01 mg compared to the rest of the treatments regarding the parameters of leaf content of total chlorophyll, carbohydrate content in leaves, total sugar in the fruit, protein content, and nitrogen. It scored 10.15 mg. 100 g fresh weight-1, 13.4 mg. g dry weight-1, 15.4 g. 100 g fresh weight-1, 7.04%, 2.61% compared to the control treatment which gave the lowest value of 5.87 mg. 100 g fresh weight-1, 8.4 mg. g dry weight-1, 13.7 g. 100 g fresh weight-1, 6.87%, 2.41% respectively.

The interaction between spraying copper and Iron elements at a concentration of 75 mg.L-1 + 10 mg.L-1 respectively showed a significant effect on the chemical properties of the strawberry plant and gave the highest value of 14.60 mg.100 g fresh weight-1, 19.0 mg. g dry weight-1, 2.91% compared to the control treatment which recorded the lowest value of 5.58 mg.100 g fresh weight-1, 3.9 mg. g dry weight-1, 1.80% respectively.

ISSN 2072-3857

Table (2) The effect of spraying iron and copper on the chemical parameters of the Ruby Gem variety of the strawberry plant.

	Chlorophyll (mg.100 g fresh weight^{-1})				Carbohydrates (mg.gm dry weight^{-1})			
copper / Iron	0	5mg.L^{-1}	10 mg.L^{-1}	mean	0	5mg.L^{-1}	10 mg.L^{-1}	mean
0	5.58a	4.75a	10.33b	6.89a	7.3ab	6.9ab	3.9a	6.1a
50 mg.L^{-1}	4.23a	5.36a	5.53a	5.04ab	8.4ab	13.2ab	17.2ab	12.9ab
75 mg.L^{-1}	7.79ab	9.14ab	14.60ab	10.51b	9.4ab	12.8ab	19.0b	13.7ab
mean	5.87a	6.41ab	10.15b		8.4a	11.0ab	13.4b	

	Sugar content of fruits (g/100g fresh weight)				Protein %			
copper / Iron	0	5mg.L^{-1}	10 mg.L^{-1}	mean	0	5mg.L^{-1}	10 mg.L^{-1}	mean
0	6.8a	12.2ab	11.7ab	10.2a	5.58a	8.08ab	6.99b	6.88ab
50 mg.L^{-1}	16.1ab	20.2b	16.8ab	17.7b	7.56ab	3.69a	6.53a	5.92a
75 mg.L^{-1}	18.4b	15.0ab	17.7ab	17.03b	7.46ab	7.80ab	7.60ab	7.62ab
mean	13.7a	15.8b	15.4b		6.87a	6.53a	7. 04b	

Spraying mango seedlings (Mangifera indica L., a local variety) with chelated iron Fe-EDTA at a concentration of 100 mg L-1 led to a significant increase in the total carbohydrate content of the leaves[10 .[

The loquat seedlings treated with chelated iron Fe-EDDHA at concentrations of 20 and 40 mg L-1 [11]. The concentration of 40 mg L-1 gave the highest percentage of nitrogen while the concentration of 20 mg kg-1 gave the highest concentration of iron in the leaves. The grape vines was tested under foliar and soil fertilization with some chelated iron compounds EDTA-Fe (1.25 g L-1 spray, 32 g addition per tree) and ferrous sulfate Fe2SO4.7H2O (0.9 g L-1 spray, 22.1 g tree-1 addition)[12]. Foliar application with ferrous sulfate achieved the best results in treating yellowing due to the increase in the concentration of iron in the leaves immediately after the first spray meanwhile foliar application with chelated iron gave the highest percentage of iron accumulated in the leaves after the third spray.

Copper has a role in controlling the rate of wilting of citrus plants. This may be attributed to the role of copper in reducing the ability of the disease to cause infection that may damage the root system of infected plants by increasing the thickness of cell walls [13]. Or, this is due to the ability of copper to suppress the pathogen at high levels. In general, copper acts as a direct inhibitor of various plant pathogens and activates the plant's defense against diseases. These results are consistent with what was found by Bahloo [14.[

The reason for the increase in the chlorophyll, carbohydrate, and some nutrient content of the vegetative system may be attributed to the role of copper in encouraging the plant to absorb elements by improving growth indicators and the ability of the roots to absorb[15.[

ISSN 2072-3857

Conclusions

-1

The study showed that spraying iron element led to a significant superiority at a concentration of 75 mg.L-1, as it gave positive results in most of the studied traits, while there were no significant differences in the comparison treatment.

-2 The study results showed that spraying copper at a concentration of 10 mg.L-1 gave a significant increase in the studied traits

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ISSN 2072-3857