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Effect of Spraying with Growth Regulators 'Atonic and Greetnal' on Some Growth Indicators and Chemical Content of Leaves of Local Fig Plants *Ficus carica* L.

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Abstract. The results of a study that examined the effects of spraying local fig plants with the growth regulators Atonic and Greetnal revealed notable variations in the majority of the vegetative traits that were examined, including stem height and thickness, number of leaves, and area, when spraying with Atonic (95.6 cm, 12.26 mm, 21.00 leaves. plant^{-1}, and 178.0 cm^2), respectively. At the 4 ml l^{-1} level, however, the Greetnal treatment was noticeably better in terms of the number of branches characteristic, recording 7.11 branches. plant^{-1}. The treatment with growth regulators at the level of 4 ml l^{-1} Atonic and 4 ml l^{-1} Greetnal substantially outperformed all examined traits, reaching 101.0 cm, 13.30 mm, 24.33 leaf.plant^{-1}, 195.4 cm^2, and 9.67 branch.plant^{-1}, respectively, indicating the impact of the interaction between Atonic and Greetnal. While the Greetnal spray treatment at level 4 ml l^{-1} was significantly superior in the leaf content of phosphorus, recording (0.249%), the atonic spray treatment at level 4 ml l^{-1} was significantly superior in the majority of the chemical characteristics studied in the experiment, including the leaf content of N and K, carbohydrates, and chlorophyll, reaching 1.831% and 1.817% and 18.35% and 20.74 SPAD, respectively. Regarding how the two experimental elements interact in both directions, the atonic spray treatment Greetnal 4 ml l^{-1} was better in every category at the level of 4 ml l^{-1}, reaching 1.997%, 0.344%, and 1.993%. 23.60 and 20.51% SPAD.

Keywords. Ficus carica, Greetnal, Atonic acid.

1. Introduction

Fig. *Ficus carica* L. family Moraceae. It is believed that the southern Arabian Peninsula is the original home of figs, a species of the mulberry family [1]. Figs are regarded as one of the earliest plants ever discovered by humans, and in Iraq, figs are mentioned in the Babylonian hymnbook around 2000 BC [2] and at the beginning of the Sumerians around 2900 BC, it needs a few effective cold hours to break the resting phase and a hot, dry summer, and the countries that occupy the lead in fig production are Italy, Greece, Spain, and Turkey. [3], and it is also grown in Iraq, but its cultivation has not expanded much despite the availability of suitable environmental conditions for its cultivation in most areas of Iraq.[4], fig production in Iraq is estimated at (9867) tons for the 2013 season, an increase of 10.4% over the production of the 2012 season, which was (8935) tons. The average production of one tree is about (23.7) kg for the year 2013, an increase of 9.7% over what it was in 2012, which was 21.6 kg.

The global production of figs is 1,064,414 tons [5], and Iraq's production of it amounted to about 0.81%, according to a report by the [6].Foliar feeding is widely used as a means of providing plants with supplementary doses of micro- and macronutrients, plant hormones, and other beneficial substances to improve their growth, productivity, and fruit quality, as it can give faster results than absorption through the roots, especially when the soil condition is not suitable for the absorption of elements. Growth regulators are widely used in agriculture, [7], such as high acidity or alkalinity and regulating many physiological processes of plants, as foliar spraying with growth regulators has a significant impact on enhancing the vegetative and fruit growth characteristics in fruit trees [8].
It also has an effect on enhancing biosynthesis in natural hormones, food making, and nutrition absorption and aids in the development of all compounds and components of plant tissue synthesis and the formation of its parts, such as proteins, carbohydrates, etc. Foliar feeding with nutrients is one of the important agricultural techniques in the production of fruit trees, [9]. The statistical analysis demonstrated the existence of a substantial effect of foliar spraying on plant growth characteristics. Plant height, stem diameter, number of leaves, and leaf area [10], foliar spraying on pear trees led to a significant increase in chlorophyll and iron contents. Among these modern scientific methods is the use of some growth regulators, including atonic and critnal, which are growth stimulants that are easily absorbed by the vegetative of plants.
They increase the transfer of plant sap and photosynthesis processes. Hence, the importance of research in studying the use of foliar spraying with growth regulators and nutrients as a new approach and the speed of root growth and branching. It also works to increase the absorption of nutrients and minerals by plants and thus increase production. Atonic Bulletin (Biostimulants are one of the most important agricultural methods adopted recently that work to improve plant growth in a way that protects the environment, and Atonic is one of the most important of these biostimulants that have proven their efficiency in improving the growth and productivity of various garden plants, which positively affect the vital processes of the plant and are frequently more obvious in harsh situations for the plant by increasing the plant's tolerance to stress and damage resulting from adverse conditions. [11,12], enabling farmers to face the pressures of increasing demand for high-quality fruits, It was necessary to conduct this study and develop recommendations detailing the impact of spraying with growth regulators Atonic and Greetnal on some growth indicators and chemical content of the leaves of fig plants planted in Basra Governorate because fig cultivation is currently experiencing an increasing decline and because there aren't many studies on it.

2. Materials and Procedures

The present investigation was carried out in the plant shade of the Agricultural Research Station at the College of Agriculture, University of Basra, during the 2022-2023 agricultural season, using local fig plants sourced from a nursery, all of uniform age at one year and under identical care conditions. The samples were transferred to the laboratories of the Department of Horticulture and Landscape Engineering at the University of Basra's College of Agriculture. Two variables were employed in the experiment: the application of three concentrations (0, 2, and 4) of the growth stimulants Atonic and Greetnal, each at a volume of one milliliter per concentration. The plants were relocated to the designated anvils, which contained a mixture of fine sand and peat moss in a 1:2 ratio. Before commencing the research, the cultivation soil was analyzed by randomly choosing samples, completely mixing them, and allowing them to air dry for 72 hours. and sieved using a sieve with a 2 mm aperture diameter. The analysis, as shown in Table (1), was conducted at the Soil Department of the College of Agriculture at the University of Basra. Consequently, each experimental unit in the investigation was equipped to accept the experimental components.

Table 1. Selected chemical and physical parameters of the soil used in the experiment.

Features	Measurement	Value
pH	1:1	7.5
Ec	dSm^{-1}	0.85
Ready Nitrogen	ppm	280
Ready phosphorus	ppm	60.68
ready potassium	ppm	192
Organic matter	%	0.067
Soil separators		
Sand	%	919.58
Silt	%	22.70
Clay	%	57.72
soil texture	Sandy	

Samples were examined in the Soil Department labs at the University of Basra's College of Agriculture.

The experiment's peat moss's chemical and physical characteristics are listed in Table 2.

Table 2. Chemical and physical characteristics of peat moss's

Features	Unit of measurement	Value
pH	1:1	6.0–5.0
Organic compounds	%	80
N	$mg\ l^{-1}$	170
P	$mg\ l^{-1}$	190
K	$mg\ l^{-1}$	215

According to the manufacturer.

The Following Characteristics Were Estimated

2.1. Physical Characteristics

- Height of plant (cm) Using a measuring tape, the plant's height was determined from the point where it made contact with the earth to the tip of its main stem.
- Stem diameter (mm) At the experiment's completion, the stem diameter was measured five centimeters above the soil surface using a vernier caliper.
- Number of branches on the main stem ($branch.plant^{-1}$): At season's conclusion, the number of branches was manually determined.
- Number of stem leaves and branches ($leaf.plant^{-1}$): The plants' leaf and branch counts were determined by hand.
- Estimation of leaf area (cm^2) The Scanner approach was used to estimate the leaf area.

According to the method of [13]. A computer and a scanner were used using the Digi Mizer program, which measures the area of the optical image of the leaves and converts it into a digital image and then determines its area very accurately.

2.2. Characteristics Chemical

2.2.1. Estimation of Nutrients in Fig Seedling Leaves

For the purpose of extracting the leaves' content of nutrients and other components, the leaves were taken from the mid-plant area where the leaves are at the peak of their balanced physiological activity, which the plant depends on in most of the basic physiological processes. The samples were placed in plastic bags marked with special marks and transferred to the laboratory, followed by a water wash to remove any remaining dust and suspended particles. Following drying, they were put in an electric oven set to 70°C and placed in perforated paper bags. equipped with fans to evacuate the air until the weight was fixed. Then the samples were ground and kept in special containers.

2.2.2. Digestion of Samples

The technique was followed in the digestion of the dry and ground plant samples of the leaves [14].

2.2.3. Estimation of the Nitrogen Element in the Leaves (%)
Using the Micro Kjeldahl instrument, the percentage of the total nitrogen element in fig leaves was calculated using the procedure outlined by [15].

2.2.4. Calculating the Percentage of Phosphorus in Leaves
Using a spectrophotometer set to measure wavelengths of 470 nm, the yellow color method of [16],approach was used to quantify the proportion of phosphorus element in fig leaves.

2.2.5. Potassium Element Estimation in Leaves (%)
The samples were processed using the [14] procedure, and the results were measured using a flame-photometer using the [15] method.

2.2.6. Calculating the Chlorophyll Content of Fresh Weight Fig Leaves (mg g^{-1})
At the end of the treatment period, the total chlorophyll in green leaves was quantified using the [17] technique, which included extracting chlorophyll from mature leaf samples using 80% acetone solvent.

2.2.7. Calculating the Total Amount of Carbs in Leaves (mg per 100 g of dry matter)
The modified phenol-sulfuric acid and colorimetric technique (PSACM) method, as reported by [18], was used to estimate it.

2.3. Statistical Analysis
The experiment was statistically assessed using the Randomized Complete Block Design (RCBD) with three replicates, and the Least Significant Difference (LSD) test was used at a 5% probability level to determine the significance of the differences [19].

3. Results

3.1. Vegetative Characteristics
Table (3) presents the isolated impact of Atonic spraying on various vegetative characteristics. The measurements of parameters include plant height, main stem thickness, number of leaves, and leaf area, which calculated 95.6 cm, 12.26 mm, 21.00 leaves per plant, and 178.0 cm², respectively. while spraying with Atonic were significantly different from one another. at 4 ml l^{-1}.

Table 3. Impact of misting with atonic on the vegetative characteristics of fig plants, local variety.

Atonic ml l^{-1}	Vegetative characteristics				
	Plant Height (cm)	Stem thickness (mm)	No. of leaves Leaf $plant^{-1}$	Leaf area (cm^2)	Number of branches (plant $branch^{-1}$
0	79.2	10.43	13.11	145.8	3.89
2	88.8	11.47	16.44	161.8	4.33
4	95.6	12.26	21.00	178.0	6.22
LSDR 0.05	7.61	0.784	1.374	10.48	1.128

Table (4) shows the individual effect of application via spraying Greetnal on local fig plants, as it is observed that the number of branches characteristic, which reached 6.22 branches, has a notable superiority.$plant^{-1}$compared to the control treatment, which reached 3.89 branches.$plant^{-1}$ after receiving Greetnal treatment at 4 ml l^{-1}.

Table 4. Impact of misting with Greetnal on the vegetative characteristics of local fig plants.

Greetnal ml l^{-1}	Vegetative characteristics				
	Plant Height (cm)	Stem thickness (mm)	Number of leaves Leaf $plant^{-1}$	Leaf area (cm^2)	Number of branches (plant $branch^{-1}$
0	84.3	10.63	13.00	151.1	2.78
2	86.9	11.42	17.78	165.8	4.56
4	92.3	12.12	19.78	168.6	7.11
LSDR 0.05	7.61	0.784	1.374	10.48	1.128

Table (5) shows the outcome of misting with Atonic and Greetnal on the vegetative growth indicators of local fig plants, as the 4 ml l^{-1} Atonic and 4 ml l^{-1} Greetnal interaction treatment was superior in all studied vegetative traits (plant height, main stem thickness, quantity and size of leaves and number of branches), which reached (101.0 cm, 13.30 mm, 24.33 leaves.$plant^{-1}$, 195.4 cm^2, and 9.67 branches.$plant^{-1}$), respectively, in contrast to the control group.

Table 5. The effect of spraying with growth regulators Atonic and Greetnal on some vegetative growth indicators of local fig plants.

Atonic ml l^{-1}	Greetnal ml l^{-1}	Vegetative characteristics				
		Plant Height (cm)	Stem thickness (mm)	Number of leaves Leaf $plant^{-1}$	Leaf area (cm^2)	Number of branches (plant $branch^{-1}$
0	0	69.3	9.17	8.00	132.9	1.33
	2	83.3	10.93	14.67	162.9	4.33
	4	85.0	11.19	16.67	141.5	6.00
2	0	91.7	11.49	13.33	152.3	3.00
	2	83.7	11.07	17.67	164.2	4.33
	4	91.0	11.86	18.33	168.8	5.67
4	0	92.0	11.22	17.67	168.0	4.00
	2	93.7	12.25	21.00	170.5	5.00
	4	101.0	13.30	24.33	195.4	9.67
L.S.D.R 0.05		13.18	1.357	2.381	18.15	1.953

3.2. Chemical Properties

Table (6) indicates the single effect of spraying with Atonic on most of The chemical properties under study were shown to alter significantly when spraying with Atonic, with the leaf content of N, K, carbohydrates, and chlorophyll coming in at 1.831%, 1.817%, 18.35%, and 20.74 SPAD, respectively. at 4 ml l^{-1}.

Table 6. Effect of spraying with atonic on some chemical properties of local fig seedlings.

Atonic ml l^{-1}	Chemical properties				
	N%	P%	K%	Carbohydrate	Chlorophyll (SPAD)
0	1.077	0.082	1.439	14.82	16.22
2	1.331	0.173	1.696	15.81	18.81
4	1.831	0.216	1.817	18.35	20.74
LSDR 0.05	0.183	0.047	0.161	1.263	1.014

Table (7) illustrates the specific impact of applying Greetnal spray on nearby fig plants. It is observed that there is a notable increase in P's leaf content, reaching 0.249%, as opposed to the control treatment, which reached 0.081%. at 4 ml l^{-1}.

Table 7. Effect of spraying with Gretinal on some chemical properties of local fig seedlings.

Greetnal ml l^{-1}	Chemical properties				
	N%	P%	K%	Carbohydrate	(SPAD) Chlorophyll
0	1.127	0.081	1.568	15.02	17.10
2	1.493	0.141	1.627	16.43	18.80
4	1.619	0.249	1.757	17.54	19.88
LSDR 0.05	0.183	0,047	0.161	1.263	1.014

Table 8 illustrates the impact of applying the growth regulators Atonic and Greetnal on the chemical characteristics of local fig seedlings. In comparison to the control treatment, the interaction treatment of 4 ml l^{-1} Atonic and 4 ml l^{-1} Greetnal exhibited superior performance across all evaluated parameters, including leaf concentrations of nitrogen, phosphorus, potassium, carbohydrates, and chlorophyll, achieving values of 1.997%, 0.344%, 1.993%, 20.51%, and 23.60 SPAD, respectively.

Table 8. Repercussions of spraying indigenous fig seedlings with growth regulators Atonic and Greetnal on certain chemical content markers in their leaves.

Atonic ml l^{-1}	Greetnal ml l^{-1}	Chemical properties				
		N%	P%	K%	Carbohydrate	Chlorophyll (SPAD)
0	0	0.637	0.053	1.180	11.820	14.510
	2	1.243	0.092	1.550	15.960	17.030
	4	1.350	0.099	1.587	16.690	17.100
2	0	1.083	0.097	1.700	15.280	18.440
	2	1.400	0.118	1.697	16.730	19.070
	4	1.510	0.302	1.690	15.430	18.930
4	0	1.660	0.092	1.823	17.950	18.330
	2	1.837	0.211	1.633	16.580	20.300
	4	1.997	0.344	1.993	20.510	23.600
L.S.D.R 0.05		0.317	0.082	0.277	2.187	1.757

4. Discussion

The application of atonic nutrient solution leads to increased leaf area due to the presence of major and minor nutrients, promoting cell division and elongation. This enhances photosynthesis efficiency, resulting in greater byproduct production. Gibberellins play a role in leaf growth expansion. Organic fertilizer and dry yeast extract spraying treatments significantly improve plant height, stem diameter, leaf area, and branch number [20].

Greetnal treatment of fig seedlings can increase branch number due to increased phosphorus accumulation in leaves. Phosphorus is crucial for nucleic acids, enzymes, fats, enzyme cofactors, and energy-rich linkages. It is essential for respiration, photosynthesis, and fatty acid representation. Phospholipids play a significant role in cell membrane formation. Phosphorus-rich diets promote cell division, growth, and root system absorption, enhancing root quality and resistance to disease. Phosphorus-rich diets are essential for plant health [21].

Spraying Greetnal nutrient solution increases plant branches due to overlapping effects of nutrients in chlorophyll and cytochromes formation, photosynthesis, energy production, and nucleic acid building. Applying Atonic increases chlorophyll content in leaves due to its ingredients contributing to molecule production and inhibiting chlorophyllase enzyme activity, resulting in increased plant nutritional status and vegetative branches. Atonik has a positive effect on most vital processes in plants, as it doubles the absorption surface, increases the total chlorophyll content and the intensity of photosynthesis, increases the content of plant hormones, lignin, proteins, carbohydrates, and minerals, increases enzymatic activity, increases cytoplasmic movement, and the application of Atonik positively affects plant growth and helps increase biomass. Atonik contains the highest percentage of nitrate reduction stimulation, which is a very important enzyme for accessing nitrogen. It stimulates the reduction of nitrates to nitrite, and this chemical reaction is particularly important for the production of proteins in plants. The active substances penetrate the plant cells, quickly converting into compounds that occur naturally in plants and perform similar functions. The significant increase in the chemical content of

fig leaves may be attributed to the nutritional effect .as it contains micro- and macronutrients, which led to an increase in the absorption of elements, the ability to grow roots, the thickness of the stem, and most indicators of vegetative growth [22].Its hormonal effect, which is one of the primary causes of the successful biostimulation in plant groups, and the presence of hormone-like substances such as sterols, polyamins, cytokinins, abscisic acid, Gibberellins, and auxins [23], in addition to its function as a fertilizer, are some of its other roles.

Extracts promote plant growth by affecting macro and micronutrients, amino acids, vitamins, and growth regulators like gibberellin, auxin, and cytokinin. They contain polysaccharides, micro- and macroelements, sterols, and nitrogen-containing substances like hormones and betaines, affecting treated plants and increasing root and vegetative system growth.[23] Growth stimulants cause a greater accumulation of nutrients like sugars, proteins, acids, and water in the cells because manganese is one of the minerals that is essential for photosynthesis, the synthesis of proteins, amino acids, and chlorophyll, as well as for its interaction with calcium, zinc, and potassium to regulate the osmotic potential of cells. [25,26].

Conclusions and Recommendations

The study's findings show that local fig seedlings respond visibly to atonic growth regulator spraying, which is something we advise doing for fig seedlings. If we want to raise key growth indicators such plant height, main stem thickness, number of leaves, leaf area, leaf content of N and K, carbohydrates, and chlorophyll, we can do so at a level of 4 ml l^{-1}; but, if we want to increase the number of branches in the plant and the leaf content of P.

We advise applying Greetnal. At the 4 ml l^{-1} level, all of the aforementioned indicators can be improved by applying a combination of Atonic and Greetnal spray to nearby fig saplings. At 4x4 ml l^{-1} in order to get the greatest outcomes from this experiment.

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