

## Effect of proline and salicylic acid on some physiological characteristics and chemical content of garlic plants *Garlic sativum* L.

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### Abstract :

This research was carried out in Al-Abayji area during the year 2022 to study the effect of spraying with the amino acid proline and salicylic acid at three levels (0,150,250) ppm for both acids.

The Results reveled the superiority of spraying the plant with salicylic acid at a concentration of (150ppm) in terms of head weight, which reaching (5.00) g. The spraying with concentration as for the level (250) ppm was superior results were recorded in to the characteristics of plant height, head weight and chlorophyll content, as it reached (35.00, 4.31, 18.12) respectively. The results of the table with regard to spraying with the amino acid proline at concentration (250)ppm showed that it was superior to each of the characteristics of plant height, chlorophyll B content, lecithin compound, which amounted to (35.66, 11.36, 132.01, 363.22, 144.80, 42.76 and 2.72) respectively.

**Key words :** Proline, Salicylic, Garlic, Chemical content, Physiological characters.

### تأثير حامض البرولين والسالسليك

#### في بعض الصفات الفسلجية والمحتوى الكيميائي لنبات الثوم *Garlic sativum* L.

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### مستخلص

نفذ هذا البحث في منطقة العبايجي خلال العام 2022 لدراسة تأثير كل من الرش بالحامض الاميني البرولين وحامض السالسليك بالتراكيز (0.150,250) ppm لكلا الحامضين .

اظهرت النتائج تفوق رش النبات بحامض السالسليك بالتركيز (150ppm) بصفة وزن الرأس حيث بلغ (5.00) غم. وتفوق الرش بالتركيز (250ppm) بصفات ارتفاع النبات ، وزن الرأس ومحتوى كلوروفيل اذ بلغت ( 35.00 , 4.31 , 18.12) بالتتابع . كما وأظهرت نتائج الجدول فيما يتعلق بالرش بالحامض الاميني البرولين بالتركيز (250) انه تفوق بكل من صفات ارتفاع النبات ، محتوى كلوروفيل ب ، مركب الأليسين ، محتوى البوتاسيوم ، محتوى الكالسيوم ، محتوى المغنيسيوم ومحتوى الزنك التي بلغت (35.66 , 11.36 , 132.01 , 363.22 , 144.80 , 42.76 و 2.72) بالتتابع .

## Introduction

The garlic plant (*Allium sativum*) is one of the important medicinal and aromatic vegetable plants that is part of the garlic family (amaryllis) and is classified among the winter vegetable crops. And magnesium, thiamine, riboflavin and ascorbic acid <sup>(1)</sup>.

Garlic is used in the medical field because it contains effective sulfur compounds in the form of cysteine, and garlic has antibiotics, biological anti-diabetics compounds, and various other antibiotics, which makes it an important source of therapeutic materials <sup>(2)</sup>.

Amino acids are necessary for the plant, as they work to increase production and improve the quality of the crop if given a spray on the plant, as they contribute to the synthesis of many important organic compounds such as proteins, amines, alkaloids, enzymes, vitamins, turbines, etc. <sup>(3)</sup>.

Treatment with amino acids, including proline, increases plant productivity and stimulates resistance to various stresses. It also plays important roles in chlorophyll synthesis, activating plant hormones, and cell division <sup>(4)</sup>. Salicylic acid is a phenolic plant hormone

that affects several essential processes, such as inducing flowering, controlling ion absorption, maintaining hormonal balance, and affecting stomata's function and photosynthesis. It has been shown to provide protection against a variety of environmental stressors, such as those caused by heavy metals, salt, drought, and temperature changes. As a result, it also effectively regulates how plants react to environmental stressors <sup>(5)</sup>.

Salicylic acid also has important effects on important physiological processes related to the development and growth of plants in normal conditions, including controlling the transfer and absorption of ions, accelerating the formation of pigments, chlorophyll and carotene, accelerating the process of photosynthesis and permeability of cell membranes and increasing the activity of some enzymes <sup>(6)</sup>.

## Materials and methods of work

The experiment was carried out in the 2022–2023 season in Al-Abayji district to study the effect of two levels of spraying with salicylic acid and the amino acid proline on some physiological characteristics and chemical content of garlic plants using a complete random design CRD and with three

replications.

On December 15, 2022, it was planted using plastic anvils that measured 30 cm in height and 30 cm in diameter. Following the experiment's conclusion and after the garlic heads were extracted, the following characteristics were recorded: tow factor A involved spraying two levels of organic salicylic acid along with the comparison treatment, which involved spraying with distilled water only at a concentration of (0, 150, 250 ppm); factor B involved spraying two levels of proline along with the comparison treatment, which involved spraying with distilled water only at a concentration of ppm (0, 150, 250 ppm):

#### Studied traits

1- Plant height in centimeters: A tape measure was used to measure the height of the plant from the level soil surface to the highest point on the plant.

2- The number of leaves on each plant can be found by counting its leaves.

3- Dry weight of the plant/gm: After the plants were put in perforated paper bags and heated to 70 °C for 48 hours, the weight of the plants was stabilized. After that, the sensitive scale was used to weigh them, and an estimate of the

dry weight of one plant was made.

4- Dry matter percentage: The plant's dry matter percentage was calculated using the formula below:

$$\text{Dry matter percentage} = \frac{\text{dry weight}}{\text{soft weight}} \times 100$$

5- The weight of one head/g can be obtained by measuring the moist head of each plant on a sensitive scale.

6- Determination of chlorophyll a and chlorophyll b in leaf tissue:

The content of chlorophyll in fresh leaves was estimated using (Adwan ,2019) <sup>(7)</sup> method, where 0.25 g of wet leaves were randomly taken, cut and crushed with a ceramic mortar in the presence of (10 ml) of acetone at a concentration of (80)%, and then separated the filtrate by a centrifugal device At a speed of (500) revolutions per minute for 15 minutes, then (1 ml) of the filtrate was taken in a test tube and the volume was supplemented to 10 ml with acetone and it was measured by a Spectrophotometer at the wavelengths 663 and 643 nm. The device was first filtered with acetone and the reading was taken according to the wavelengths, and the chlorophyll was

calculated according to the following equations:

$$\text{Chl a} = 12.25 A_{663.2} - 2.9 A_{646}$$

$$\text{Chl b} = 21.5 A_{646.8} - 5.10 A_{663.2}$$

As the numbers:

2.9, 5.10, 12.25, 21.2 are constants.

7- Determination of the compound lecithin.

### Allicin extraction

Garlic cloves were peeled and their outer skin smashed in a garlic press. After that, the squeezed garlic was gathered and thoroughly blended in a beaker. Weighing 700–900 mg of the crushed mash, it was then put into a 50 ml centrifuge tube. After adding 25 ml of cold water to the sample with a volumetric pipette, it was promptly sealed and vigorously stirred for 30 seconds. The tube cap was held while shaking to prevent heat transmission from the hands. To dilute and mix the solution, another 25 ml of cold water was added, and it was shaken for an additional 30 seconds. Every sample is placed in an HPLC vial, sealed for injection, and filtered through a 0.45 µm glass filter <sup>(8)</sup>.

### HPLC conditions

The separation Column was C18 - ODS (4.6 mm × 250 mm) , AND THE

mobile phase methanol : water (50:50), flow rate: 1.0 ml/min, detector: 240 nm, injection Vol.: 50 µl, column temperature: 28°C .

8- Estimation of some elements in plants.

The components Plant samples were measured in the gathered, dried, and grounded plant samples, and the plant powder was either wet washed or acid-digested in accordance with the (APHA method, 2017) <sup>(9)</sup>, wherein a Griffin beaker cup (25 ml) was filled with 3 g of the powdered plant sample to be digested, followed by the addition of 3 ml of a concentrated perchloric acid solution, a watch glass to cover the cup, and silent heating on an electric hot plate. In order to finish the digestion process, we also gradually increased the temperature. After allowing the mixture to cool, we added an additional 3 ml of strong nitric acid solution, covered it, and heated it until the procedure was finished, at which time we got The mixture produced “light colored digestate,” a transparent, light-hued form that we evaporated as we got closer to the drying stage. Then, we added 5 ml of a hydrochloric acid solution diluted with water in a 1:1 ratio. After that, we heated the mixture

to dissolve the remaining sample, followed by the addition of distilled water. Finally, we filtered the mixture to remove any remaining insoluble materials, and the volume of the solution was adjusted to a volume (100 ml or 50 ml or less) based on the expected concentration in the samples. At this point, the sample was ready for analysis. An atomic absorption instrument type (SHEMADZU AA 7000) was used to test the absorbance of these digested samples.

### Statistical analysis

The results were analyzed according to the simple complete random design (CRD) and the method explained by (Al-Rawi and Khalaf Allah 1980) <sup>(10)</sup> and using the SAS analysis program, and then the significance test according to Duncan's polynomial test at the 0.05% probability level.

### Results and discussion

It is study from the results of the table that the spraying with both acids and all the concentrations used for the plant height is superior compared to the control treatment, which showed the lowest plant height of (26.00) cm. <sup>(11)</sup> for the chamomile plant, and salicylic acid increases the rate of mineral absorption from the soil into the plants

and increases the process of photosynthesis, which leads to an increase in plant height.

As for each of the characteristics of the number of leaves of the plant, the dry weight of the plant and the percentage of dry matter, it appears from the table that there are no significant differences between the comparison treatment and the acid spray for these traits. For the number of leaves of the plant, this was reflected in the characteristics of the dry weight of the plant and the percentage of dry matter.

As for the characteristic of head weight, the table shows the superiority of spraying with salicylic acid at a concentration (150)ppm with the highest weight per head of (5) g, while the comparison treatment showed the lowest head weight of (2.45 g). The reason may be that spraying with salicylic leads to raising the efficiency of plant absorption. It provides nutrients from the soil, increases the rate of photosynthesis and activates enzymatic reactions, and then speeds up vital processes and thus increases the weight of the head, and this is consistent with what was found <sup>(12)</sup>.

It is noticed from the table with regard to the content of chlorophyll A,

the superiority of spraying with salicylic acid at concentration (250) with the highest content of chlorophyll A reached (18.12) compared with the control treatment that gave the lowest content of (10.48) percent. The reason is that spraying with salicylic acid has a positive role in activating the vital processes of the plant and stimulating the construction of chlorophyll pigments and the formation of plastid granules, thus increasing the content of chlorophyll a.

As for the content of chlorophyll b, spraying with proline acid at a concentration (250)ppm was superior to the highest content of chlorophyll b, which reached (11.36) compared to spraying with the comparison treatment, which showed the lowest content of (3.31). Chlorophyll and the formation of plastid granules, thus increasing the content of chlorophyll, and this is consistent with what was found <sup>(13)</sup>.

With regard to the chemical content of the plant, it was clear from the table that the lecithin compound increased when spraying with proline acid at a concentration (250)ppm with the highest content of (132.0), while the control treatment gave the lowest content of (85). The reason is due to the effec-

tiveness of the amino acid proline in stimulating the physiological and vital processes of the plant. And an increase in metabolic processes that results in an increase in the accumulation of lecithin, and this is consistent with what was mentioned <sup>(13)</sup>.

The table shows the superiority of spraying with proline acid at a concentration (250)ppm with the highest potassium content of (363.2) compared to the control treatment that gave the lowest potassium content of (324.82). And the development of a robust plant that can carry out its essential functions, as well as boosting these functions and transpiration and photosynthetic processes, which will improve the plant's ability to absorb nutrients and water and, consequently, potassium. The result agreed with what he found <sup>(14)</sup>.

With regard to calcium content, the table shows the superiority of

spraying with proline acid at concentration (250)ppm with the

highest content of (144.80), while the comparison treatment showed

the lowest calcium content of (120.19). The reason is due to the active role of the nitrogen element present in the amino acid proline in increasing the vital activities of the plant



and the process of transpiration and photosynthesis, as well as increasing the efficiency of the plant to absorb this element.

It is noted of the results of the table that spraying with proline acid at concentration (250)ppm with the highest magnesium content was (42.76), while the control treatment gave the lowest content of (24.52). This element and its transfer to the places where it is stored in the lobes by potassium element, the result agreed with what was found <sup>(15)</sup>.

With regard to zinc content, the results of the table showed the superiority of spraying with proline acid at a concentration (250)ppm with the highest content of (2.72) compared to the comparison treatment that gave the lowest content of (1.17). This increase may be attributed to the role of these elements in increasing of the activity of vegetative and root growth, which increases the absorption of plant for this element .

### Conclusions

1- Spraying with salicylic acid at a concentration of 150 ppm is superior to the highest head weight.

2- Spraying with the amino acid proline at a concentration of 250 ppm

outperformed most of the vegetative characteristics and allicin content in addition to the content of mineral elements.

3- The garlic plant responded positively to treatment with amino acids.

### Recommendations

1- Treating garlic plants with salicylic acid if the aim is to obtain the greatest weight per head.

2- Treating garlic plants with the amino acid proline if the aim is to obtain the greatest content of allicin and mineral elements.

3- Conduct further research and studies on the garlic plant using other amino and organic acids in different concentrations.

character- stics	factors												
	Zn mg / gm	Mg mg / gm	Calcium content mg / gm	Potas- sium content mg / gm	lecithin content mg / gm	chloro- phyll b %	chloro- phyll a %	head weight gm	Dry matter percent- age %	Dry weight of the plant gm	number of plant leaves	plant height cm	
Control	1.17 e	24.52 e	120.19 e	324.82 e	85.00 e	3.31 d	10.48 e	2.45 c	18.04 a	0.85 a	4.6 a	26.00 b	
	1.62 d	30.47 d	124.79 d	340.01 d	96.77 d	9.78 b	16.12 b	5.00 a	21.49 a	1.67 a	7.33 a	33.66 a	S-150
	2.23 b	38.71 b	139.69 b	350.47 b	125.93 b	9.03 b	18.12 a	4.31 ab	19.77 a	1.68 a	7.00 a	35.00 a	S-250
	1.91 c	33.75 c	130.55 c	345.90 c	115.04 c	8.04 c	12.59 d	4.22 ab	17.42 a	1.24 a	6.33 a	33.33 a	P-150
P-250	2.72 a	42.76 a	144.80 a	363.22 a	132.01 a	11.36 a	14.71 c	3.96 b	20.28 a	1.56 a	7.37 a	35.66 a	



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