

## Allopathic Effect of Garlic Plant to Improve Potato (*Solanum Tuberosum L.*) Rotting Plant Warning

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**Annotation:** Potatoes are an economically important plant worldwide, one of the problems of growing potatoes plant is the delay in the root germination process may 7 weeks, and the use of plant hormones as a type of growth stimulants that help in root germination and elongation is considered expensive and costly materials with limited use, in addition to the fact that they may cause various environmental problems on the one hand, and on the other hand ,growing the plant in the soil, parasites and worms that cause a loss in the plant crop and productivity. In addition to the death of parts of the plant and its loss or delay in root growth. Garlic is plant known for its chemical composition that prevents the growth of germs and antioxidants that help the plant grow by removing of ROH, in this experiments aqueous extracts of garlic gloves were used at concentrations of (0.0,10.25,50,75 g/L) by watering the soil that was planted in potato tubers. The results obtained through the experiment showed that garlic plant greatly stimulated root germination in potato tubers and shortened the time for germination. It was noted that

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concentration 25% was the best among the concentration used and the result was significant growth at  $p \leq 0.05$  by 75% compared to the control treatment through quantitative growth in number, length, thickness and number of lateral branches of the roots in addition to an improvement in the fresh and dry weight of the roots, it was also noted through the results that there was an increase in the activity of antioxidant enzymes.

**Keywords:** Potato plant, garlic gloves, planting root traits, Chemical composition.

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## Introduction:

Allopathy refers to all effectiveness direct or indirect of plants upon other plants or their associated with other plants by production of allelochemicals (Zhang, 2021). The allelochemicals released from the plants and done as a defense system against foreign organisms, herbivore predation, or competition from other plants (Kong *et al.*, 2019). The effect of allelochemicals can act either positive or negative on the growth of the surrounding plants (Khamare *et al.*, 2022). Allopathy is derived from two separate Greek words, allele meaning of each other or mutual and pathos meaning to suffer or feeling (Willis, 2007). Upon release, the allelochemicals can suppress the germination, growth, and establishment of the surrounding plants or modify the soil properties in the roots by influencing the microorganisms community (Weir *et al.*, 2004; Zhou, 2013), so allopathic substances play an important role in regulating the plant communities, allelochemicals are produced by plants as secondary metabolites such as phenols, polyamines, flavonoids, fatty acid, (Vyvyan, 2002; XIE, 2024). The use of allopathic compounds as bio-herbicides or bio-pesticides in agricultural systems has several benefits in contrasted with common synthetic products. Because of the natural origin (Hossein *et al.*, 2016).

Potato (*Solanum tuberosum* L.) is an annual herbaceous, from Solanaceae family and genus Solanum, its most commonly cultivated tuber crop (Reddy, 2018), potato used in vegetable and processed foods and industries for starch, this crop represents the most fourth crop after wheat, rice and maize *Solanum tuberosum* contains more carbohydrate, high energy and vitamin C (Anning *et al.*, 2021).

Garlic (*Allium sativum* L.) from Liliaceae family is one of the most significant bulbous crops farmed globally, and the second cultivated crop in Allium species after Onion. It is frequently used in food flavoring (Sai *et al.*, 2024). this plant perennial with tall white thin flat leaves and tiny white flowers and bulbils. It is a multiple or compound bulb consists of smaller bulbils called 'cloves' and is surrounded by a thin white or pinkish papery sheath. Garlic cloves are the plant most cost-effective component. Also garlic extracts and oil have the powerful effects against insecticides and fungicides (Kumar *et al.*, 2014; Khumar, 2022), Green garlic is high in carbohydrates (28%), protein (6.2%), minerals (0.3%) and essential oils (0.1-0.5%), and some fat, and vitamin C, the medicinal effect of garlic appears due to the many components in garlic extract that are of great importance, such as phenols, polysaccharides, sulfur compounds, flavonoids and terpenes (Memane *et al.*, 2008; Saber

Batiha *et al.*,2020), the aim of research to evaluate allopathic effect of .aqueous garlic gloves extract to stimulate rooting of potato tuber plant.

### **Materials and Methods:**

The research was conducted in Biology department, factually of science, Basra university in growth chamber ( $22\pm 3$  / 85 humidity) in October 2023 for three weeks to record the effect of aqueous extract for garlic gloves on rooting of potato tuber plant. Factorial experiment was carried out in completely randomized design with five. replications each with five treatments, and correlation was used to showed positive correlation between treatment and their effect in root traits, the potato tubers (white potatoes) and garlic cloves were obtained from an agricultural faculty in Basra university

### **For garlic extraction:**

Garlic cloves were dried and grinded, the concentrations for the experiment were prepared by dissolving 0.0, 10,25,50 and 75 g in one liter of distill water, each separately, At room temperature. The solutions were dissolved at room temperature using a shaker for three hours. The solution was filtered by filter paper No.3 and the extracts were prepared for the experiment, potato tubers were washed with tap water, then sterilized for two minutes in 2/2 sodium hypochlorite, and washed twice with distilled water and placed in plastic pots (15/30cm) after placing  $\frac{1}{2}$  w/w sandy clay mixture soil in it, then watered with the concentrations prepared from garlic extract. Watering was done twice a week, while the control concentration was watered with distilled water, and the data were recorded after three weeks. After collection potato tubers, immediately washed and tack the data of morphologic traits ,also fresh weight of growth roots was measured, the roots were placed in an oven  $70^{\circ}\text{C}$  for 48h. also measured of number of roots, thick, number of lateral hairs, roots long, fresh and dry weight of growthing roots. Mean value were compared by Duncan, multiple. range test at.  $p\leq 0.05$ .

### **Total soluble carbohydrate:**

Total soluble carbohydrate estimated according to. Watanabe *et al.* (2000) 1g of. powdered from dray roots with 10ml ethanol alcohol then transfer the samples to centrifuge 1500 C in 15min., total soluble carbohydrate was estimated by standard glucose curve.

**Amino acids:** According to Lee and Takahashi, (1966) ,1g grade roots incubate with 10ml ethanol al -cohol 70% for 24h. centrifuge was used 12000 C min. evaluate of amino acids using spectrophotometer 570nm and use ethanol al-cohol to measured control.

### **Antioxidant enzymes activity estimation:**

Fresh tissue of roots was prepared and grounded with liquid nitrogen and extract by 2ml of 100m from phosphate buffer at ph. = 7.5, complete steps for extract by method of. Ying *et al.*,(2018).

## **Results and Discussion**

### **Morphological traits:**

Through the observation recorded, it was noted that potato tubers were treated with aqueous extract of garlic plant at different concentrations 0.0,10,25,50,75 g/L significant effects were shown in the growth characteristics and rooting the potato tubers, it was noted that the number of planting roots increased significantly with all garlic treatments compared with control treatment. Showed an increase in root growth was showed at rate 75% in the number of planting roots, especially at a concentration of 25g/L, this concentration was the best in recording data on the number of roots, as it reached a mean of (25.58) compared to the control treatment, which was (4.22) An increase in root length was also observed, table (1) and shape (1,2).

When treating the aqueous garlic extract compared to the control treatment, the best mean was recorded at a concentration of 25g/L ,which was a mean of root length ( 12.66cm) compared to the control treatment which was ( 1.21cm ) As for the number of lateral hairs and the thickness of the root hairs, it was noted that they had increased significantly in all concentrations of the aqueous

garlic extract, with an advantage appearing for the concentration of 25g/L, which recorded a mean of ( 12.31 ) and ( 5.64mm ) in both the numbered of lateral hairs and the thickness of the root hairs, respectively compared to the control treatment which was (12.31) and (0.24mm) in lateral hairs and root thickness. respectively, The fresh and dry weight of roots significantly improved and increased in all treatments of aqueous garlic extract and improved clearly at concentration 25g/L compared to the rest of the concentrations, it was at a mean of ( 39.18 g ) and (4.39g) in the fresh and dry weight respectively was compared to the control treatment, which was ( 12.31mg/g) and (1.09mg/g) table (1). So showed in table 2 positive correlation between treatments and root traits.

The phenotypic characteristics of the plant are considered among the most important indicators observed with some materials, through this study, which was conducted on the characteristics of the roots which grow after potato tubers which treated with different concentrations of garlic extract were showed in rooting potato tubers, this indicates that the garlic plant is one of the distinctive plants that contain antioxidant

**Table. 1 Shows Effect of treatments of garlic gloves extract on morphological traits of potato roots.**

Treatments g/L	No. Roots	Root Length cm	No. LH	Thick of Roots mm	F. Wt. mg/g	D.Wt mg/g
0.0	4.22b	1.21g	12.31q	0.24h	4.15j	1.09s
10	20.11c	10.11a	20.12a	5.56a	12.32k	3.15v
25	25.58d	12.66a	39.18r	5.64a	14.46a	4.39o
50	28.99f	11.89a	30.24a	5.58a	14.03a	4.05p
75	21.55e	10.49a	30.02a	5.21i	12.12a	3.03a
	P≤0.05	P<0.001	P<0.001	P<0.001	P<0.001	P<0.007

Results show Mean values followed by the similar letters within a column are not significantly different from each other at  $P \leq 0.05$  (Duncan's multiple range test). (R. L Root Length, R. TH Root Thick, R. No Root number, No.LR Number Lateral Hairs, FWt. Fresh weight).

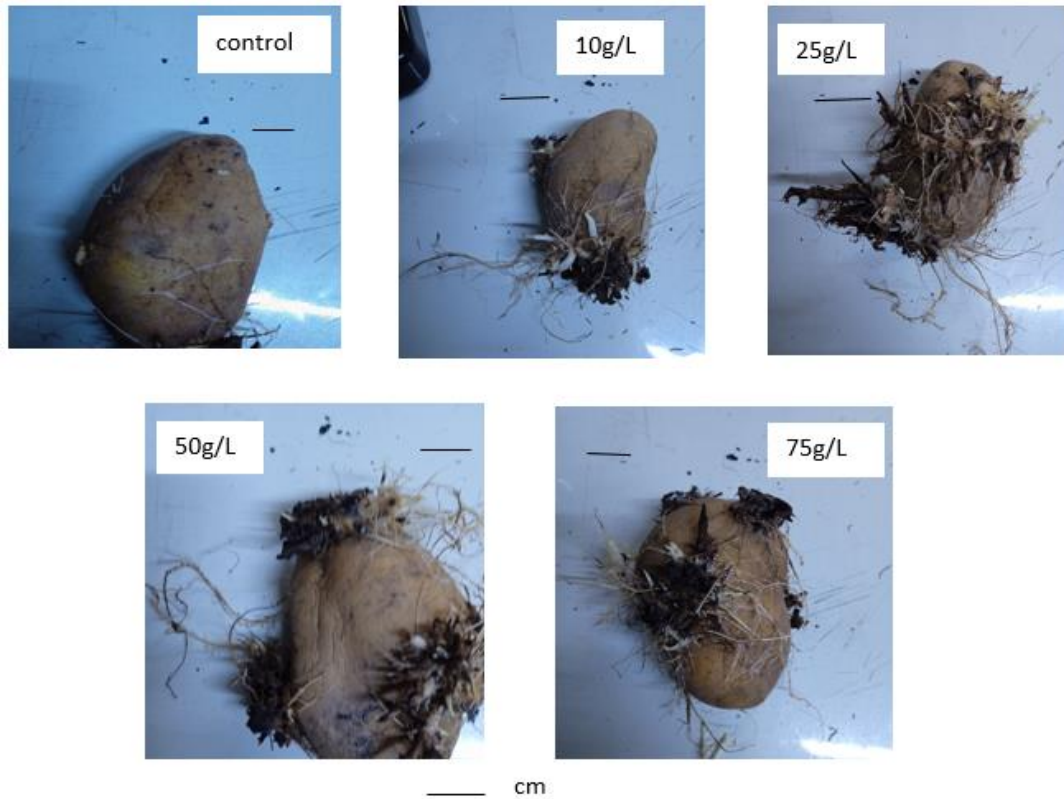
**Table.2 Showed correlations between morphological traits and treatments.**

Correlations		R.Lcm	Treatmentsg. L	R.THmm	R.No	N.LR	F.Wtmg. g	D.Wtmg. g
R.Lcm	Pearson Correlation	1	.558	.981**	.974**	.867	.998**	.969**
	Sig. (2-tailed)		.328	.003	.005	.057	.000	.007
	N	5	5	5	5	5	5	5
Treatmentsg. L	Pearson Correlation	.558	1	.538	.594	.573	.525	.435
	Sig. (2-tailed)	.328		.349	.290	.313	.364	.464
	N	5	5	5	5	5	5	5
R.THmm	Pearson Correlation	.981**	.538	1	.941**	.764	.980**	.914*
	Sig. (2-tailed)	.003	.349		.017	.132	.003	.030
	N	5	5	5	5	5	5	5
R.No	Pearson Correlation	.974**	.594	.941**	1	.844	.979**	.966**
	Sig. (2-tailed)	.005	.290	.017		.072	.004	.007
	N	5	5	5	5	5	5	5
N.LR	Pearson Correlation	.867	.573	.764	.844	1	.854	.900*
	Sig. (2-tailed)	.057	.313	.132	.072		.066	.038
	N	5	5	5	5	5	5	5
F.Wtmg.g	Pearson Correlation	.998**	.525	.980**	.979**	.854	1	.976**
	Sig. (2-tailed)	.000	.364	.003	.004	.066		.005
	N	5	5	5	5	5	5	5

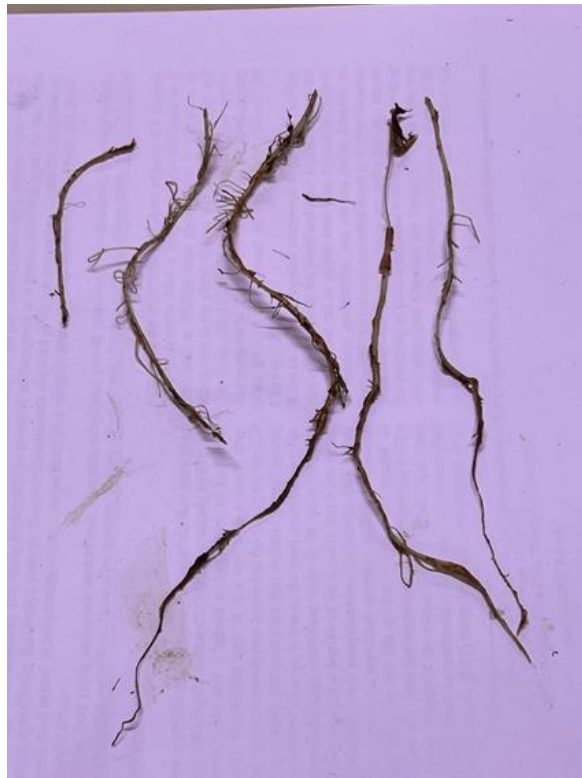
\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

R. L Root Length, R.TH Root Thick, R. No Root number, N.LR Number Lateral Hairs, F. Wt. Fresh weight.



**Shape 1: Showed effect garlic extract on rooting of Potato plant (*Solanum tuberosum* L.)**



**Shape (2) Showed the differences between roots long by effect of garlic extract on rooting of potato plant (*Solanum tuberosum* L.)**

and antibacterial as antioxidants help stimulate growth by eliminating free radicals (Adeleke,2015; Sai *et al.*,2024), it also means that helps in obtaining a suitable environment free of germs surrounding the roots, which helps them to grow ideally without polluting effects in the soil.

As for the fresh and dry weight of potato tubers roots with different concentrations of garlic extract a clear improvement was observed in these two indicators, with concentration 25g/L being the most prominent, table (1) this is consistent with what the researcher mentioned, Abbasifar *et al.*,(2020),he noted from a study on some cut plants and fruit trees and their treatment with garlic extract that all concentration that improved the most in the characteristics of these plants especially in 25g/L which has more modulate ,table (1) and positive correlation in all treatments table (2).

It is clear from this study that Aquinas extract of. garlic contains many allopathic compounds (.Wang *et al.*,2015) in addition to its antimicrobial properties (El-Amary and El-Sayed,2021) which means that garlic extract prevents many diseases and prevents the growth of many bacterial colonies in the soil, which is the environment surrounding potato tubers. It was shown through the differences observed in the effect of different concentrations that the garlic extract had an effect on the rooting of potato tubers roots, the garlic extract contains the hormone auxin, which is a natural hormone found in garlic, as the researchers mentioned), the chemical properties of garlic appear in the form of allelochemical compounds , such as Portales-Peye *et al.*,(2015);Sadaqa *et al.*,(2016) , and that they appeared to be compounds with positive effects, bio stimulants are a group of natural compounds that can be used to help plant growth, either by spraying or by treating cut tops, most of these substances the growth process, as well as through their hormonal properties (Pacholezak *et al.*,016),these materials together can enhance the growth process because natural materials can modify growth and develop ,the growth process in the roots leads to a clear improvement in all the plants phenotypic growth characteristic.

### **Chemical analysis:**

#### **Free amino acid**

are known to be compounds that contain an amine and a carboxyl group and vary in the side chain R which determines the type of amino acid (Wade,2012),there is a major role for amino acids in plants as they participate in the synthesis of plant hormones such as tryptophan which is the starting compound for the synthesis of the auxin hormone, and methionine for synthesis of ethylene hormone, amino.acids also play important role in the synthesis of osmotic regulators during changes in the stresses surrounding the plant( Farooq *et al.*,2015).Through the results obtained from the experiment in treating potato tubers with different concentrations of garlic gloves extract ,it was appeared that the mean level of amino acids increased significantly in all treatments with more modulate of 25g/L treatment which have mean(38.68mg/g) compared to the control(22.24mg/g), and positive correlation between free amino acid and garlic treatments ensured that ,table( 3,4)also showed from the experiment all concentration of garlic extract stimulated rooting and growth of potato tubers , which is evident will improvement vegetative growth characteristics, and also led to an increase in N absorption, which enhanced the level of amino acids ,related with increase in the activity of amino acid synthesis enzymes, on the other hand, amino acids play a role in reducing oxidative stress caused by the accumulation of oxygen related with increase in vital activities in the plants, this is consistent with what was mentioned by Mansour,(2000) it was mentioned that amino acids increase with increase in vital activities to remove oxidative stress elements, also growth hormones play a role in stimulating and increasing grow when nitrogen is sufficiently available ( Kumar,2021 ; Fathi,2022 ),and this consonant with mentioned of Abbasifar .,*et al.*(2020) when treatment some plant by garlic extract.

#### **Total soluble carbohydrates**

By observing the data recorded from the treatment of potato tubers with garlic gloves extract and studding its effect on the level of soluble carbohydrates in potato roots ,a clear and significant improvement in the level of total soluble carbohydrates was observed, the best improvement was at

concentrations of 25g/L of garlic extract, which were ( 12.87mg/g ) compared to the control treatment, which was (5.08mg/g ) it is also known that soluble carbohydrate low significant among treatments, table(3),and showed positive correlation between total soluble carbohydrate and treatments, table (4) .Carbohydrate metabolism is one of the basic that are affected by environmental changes surrounding the plant, which many be affected negatively or positively ,as the plants , cycle continuity of the flow of carbohydrates from source to sink ,it appears from this study that the level of soluble carbohydrates is affected by treating the potato plant with garlic gloves extract, the activity of carbohydrate anabolic enzymes was activated with treatments ,that evidence linked to the increased absorption of nitrogen from the soil ,and this is consistent with what was mentioned by (Arbona *et al.*,2005;.Ding *et al.*,2019) and (Macias *et al.*,2014).It was mentioned that the availability of nitrogen greatly helps in the manufacture of enzymes ,and their activity causes an increase in the manufacture of carbohydrate ,there are many researchers who have prevent that the manufacture of enzymes in a good way leads to a direct effect on carbohydrate metabolism, such as Sadaqa *et al.*,(2016) and Ahmad and Ali,(2021)in study of the allopathic effect of the Garlic plant and its effect on the *Allium sepa* plant. This clear from this that garlic extract, modulates the level of phosphate absorption, and increases the concentration of sugars, which is linked to improved absorption of mineral elements from the soil, which are necessary to an increase the production,.and activity of carbohydrate-building enzymes, this is consistent with what was mentioned, Abbasifar *et al.*, (2023) on some cutting plants.

**Table 2. Effect of treatments of garlic extract in biochemical characteristics of potato plant.**

Treatments	T.SC.	F.AM	CAT	SOD
(g/L)	(mg/g)	(mg/g)	(unit/min/g)	(unit/min/g)
0.0	5.08 b	22.24e	24.18g	10.43k
10	8.22 a	26.52a	37.82h	18.22s
25	12.87a	38.68f	47.32a	22.53a
50	11.10 c	25.11a	44.54a	21.76a
75	10.48d	26.54a	44.87a	23.14a
<b>P&lt;0.05</b>	<b>P&lt; 0.001</b>	<b>P&lt;0.002</b>	<b>P&lt;0.04</b>	<b>P&lt;0.007</b>

Results show Mean values followed by the. Similar letters within a column are not significantly different from each other at  $P \leq 0.05$  (Duncan's multiple range test.( T.SC Total soluble carbohydrate, F.AM Free Amino acid, SOD Super Oxide Dismutase, CAT. Catalase enzyme).

#### **Antioxidant enzyme CAT and SOD:**

By study of effects of garlic extract on rooting of potato tubers, see the significantly increase at  $p \leq 0.05$ ,positivily effect by increase the activity of antioxidant CAT and SOD ,the activity of antioxidant enzyme increase with increasing the concentration of treatments compared with control treatment, with superior of activity of CAT and SOD in 25g/L to compare with another treatments ,so recorded (47.32 , 22.53 mg/g) of CAT and SOD respectively compare with control treatment (24.18 and 10.43 mg/g) in CAT and SOD respectively ,table(3) with positive correlation was showed between antioxidant enzymes and treatments table (4),many researchers recorded changing of antioxidant activity with treatment by some materials such as by Sabry *et al.*,(2023) on French bean plant if treatment with salicylic acid ,these studies showed increase in antioxidant activity with increase metabolic processes or subject plants to any

Table 4. Showed correlation between biochemical characteristics and treatments.

		Correlations				
		Treatments g.L	T.SC	F.AM	SOD	CAT
Treatmentsg .L	Pearson Correlation	1	.082	.121	.768	.692
	Sig. (2-tailed)		.896	.846	.129	.195
	N	5	5	5	5	5
T.SC	Pearson Correlation	.082	1	.966**	.682	.756
	Sig. (2-tailed)	.896		.007	.204	.140
	N	5	5	5	5	5
F.AM	Pearson Correlation	.121	.966**	1	.651	.721
	Sig. (2-tailed)	.846	.007		.234	.169
	N	5	5	5	5	5
SOD	Pearson Correlation	.768	.682	.651	1	.991**
	Sig. (2-tailed)	.129	.204	.234		.001
	N	5	5	5	5	5
CAT	Pearson Correlation	.692	.756	.721	.991**	1
	Sig. (2-tailed)	.195	.140	.169	.001	
	N	5	5	5	5	5

T.SC Total soluble carbohydrate, F.AM Free Amino acid, SOD Super Oxide Dismutase, CAT.

#### Catalase enzyme

stresses, means increase in ROS related by increase of metabolic proses, that observed in changing of characteristic of morphological traits of planting of roots of potato tubers, so the activity of antioxidant enzyme increase to element the ROS such as  $H_2O_2$  and  $O^-$ , that is consistent with Aline *et al*, (2023) on some plant and Shatha (2021) on Fenugreek plant.

#### Productivity of rooting of potato tubers:

By results which obtained with this study, an increase significantly of rooting of potato tubers if treated with garlic extract concentration especially 25g/L have modulated indicators in rooting of potato tubers, so noted increase in all morphological traits, soluble carbohydrate, amino acid and antioxidant activity to promote potato rooting.

#### Conclusion:

From this experiment concluded that aqueous extract of garlic cloves by different concentration 0.0,10,25,50,75g/L provide all morphological traits of rooting potato tubers significantly modulate and showed from this study the best concentration of garlic extract is 25g/L have significantly measurements compared with control treatment and low significant with other concentration. So, thick, number of rooting root, number of lateral hairs, and fresh, dry weight of potato roots, all traits with chemical analysis, soluble carbohydrate, amino acid, antioxidant enzyme CAT, SOD all indicators that have modulates measurements and have 75% increase, so modulate rooting and growth of potato tubers by aqueous garlic extract.

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