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EFFECT OF FOLIAR SPRAYING WITH YEAST AND SPIRULINA PLATENSIS EXTRACT ON SALINITY TOLERANCE IN TOMATO PLANT

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ABSTRACT: Irrigating with saline water helps mitigate the scarcity of agricultural freshwater resources, particularly in arid regions. Yeasts rapidly colonize plant surfaces, use nutrients from many sources, survive in a relatively wide range of temperatures, produce no harmful metabolites and have no harmful effects on the final food product. Algae extracts contain a series of bioactive compounds and signaling molecules, as well as mineral and organic nutrients, and thus algae extracts can be used as plant bio-stimulants due to their ability to promote plant growth in suboptimal conditions such as saline environments. In this context, the present study aims to evaluate the foliar application of yeast extract and spirulina algae alone or in combination, as a strategy, to mitigate the salinity adverse effects on tomato *(Solanum Lycopersicon*) plant growth. Growth. The factorial experiment was conducted in a randomized complete blocks design, consisting of four levels of water salinity (0, 1000, 2000, and 4000 mg/L of water) and one dose of yeast extract and *Spirulina platensis* extract (2 g yeast/L, 100 mg/L water, respectively). In general, the results showed an increase in proline and antioxidant enzymes peroxidase and polyphenol oxidase, meanwhile a decrease in protein and photosynthetic pigments in plants under salt stress. On the other hand, an increase in the studied traits has been observed when treated with yeast and *spirulina* while the treatment with yeast has shown a decrease in proline concentration. The use of foliar spray with yeast and *Spirulina platensis* made tomato plants tolerant to salt stress and reduced its negative impact. The results suggest decisive roles of yeast and *Spirulina platensis* extract in the management of salt-induced adverse effects in economically important tomatoes.

Key words: Salinity, tomato (*Solanum lycopersicon*), Yeast extract, *Spirulina platensis* extract, Proline, Enzyme activity.

INTRODUCTION

Salinity is a form of abiotic stress impacting plants globally. It diminishes photosynthesis, photorespiration, and protein synthesis (Kasim *et al.*, 2016). There is a decline in the number of leaves affecting plant productivity (Abdelmoteleb *et al.* 2022). It also reduces plant growth due to the excessive absorption of sodium ions which negatively affects the plant (Mostafa 2015). Salt stress occurs as a result of the accumulation of dissolved salts resulting from the use of high or medium amounts of saline water in the irrigation of plants (Al Harbi, 2015), which causes much damage to plants, as it works to close the stomata, which leads to the inhibition of the photosynthesis process, which causes a kind of stress called oxidative stress (El-Katoey, *et al.*, 2021). Salt stress also results in another type of abiotic stress, drought stress, which affects the seeds and prevents the roots from performing their activities. High levels of salinity weaken the root structure and affect root elongation due to their hindrance to cell division (Siddiqui *et al.,* 2017; Siddiqui *et al.*, 2020) and disrupt the ionic balance due to the accumulation of sodium and chloride ions that reduce the absorption of other mineral elements like potassium and calcium (Mutale- joan *et al.,*

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2021). Tomato *(Solanum lycopersicum)* which belongs to the family (Solanaceae). It is one of the most famous vegetables because it is a good source of vitamins and minerals (Ali *et al.,* 2011; Albouza and Aboud, 2013) and ascorbic acid as well as antioxidants, which can reduce cardiovascular diseases (Mazumder *et al.,* 2021).

Tomatoes are exposed to abiotic stresses, the most important of which is salt stress (Shin *et al.* 2020), which reduces the growth of roots and branches of tomato plants, increases leaf senescence and reduces crop yield (Žižková *et al.* 2015). Soil irrigated with high amounts of saline water needs the availability of large quantities of fresh water to drain the excess salts and toxic sodium ions, but due to the lack of rain and the difficulty and slow process of desalination agriculture suffering from salinity (Tnay 2019; Siddiqui *et al.* 2020). It was necessary to use alternative methods by using inexpensive and effective products that do not affect human health or the ecosystem such as yeast and spirulina. Yeast plays an important role in plant tolerance to environmental stresses, and yeast extract contains a complex of minerals, vitamins (B1, B6) (Marzauk *et al.*, 2014; Atawia *et al.,* 2021) and amino acids that stimulate cell division and DNA synthesis (Taha *et al.,* 2021) in addition to containing phytohormones such as cytokinin and auxin that delay leaf senescence and enhance protein synthesis (Atawia *et al.,* 2021). Hegab *et al.,* (2005) found that using yeast spray on Valencia orange trees improves growth and fruit formation and increases fruit weight and size (Abd El-Motty *et al.,* 2010). Marine algae extract also stimulates plant growth because it contains auxin and cytokinin (Atawia *et al.,* 2021) and increases chlorophyll and antioxidants in plants (Atawia *et al.,* 2021). Among these algae is Spirulina platensis, a blue-green, spiral-shaped organism that scientists categorize as algae due to its chlorophyll content, which is akin to that found in higher plants. It was used in the past as a human food because it contains proteins, vitamins, carbohydrates, and pigments such as carotenoids and chlorophyll A. It also has anti-cancer and antiviral properties, which is considered antioxidant and lack toxicity. (Ali and saleh. 2012). It also stimulates plant growth due to the presence of plant hormones (auxin, cytokinin, gibberellin) and contains various nutrients (Atawia *et al.,* 2021). Yassen *et al.,* (2019) tested the effect of foliar spraying of spirulina extract on a lettuce plant, which increased plant growth, leaf number, and yield.

Therefore, this work aims to study the effect of spraying yeast extract and Spirulina extracts, either individually or in combination, in relieving salt stress on tomato plants.

MATERIALS AND METHODS

The experiment was conducted in the College of Science, Qassim University, Kingdom of Saudi Arabia. The investigation was carried out to study the individual and combined effects of salinity, yeast, and *Spirulina platensis* on photosynthetic pigments and chemical constituents of tomato plants. Tomato seedlings cv Super Strain ‘B" are 80 seedlings planted in pots with a diameter of 15 cm each and containing (sand + peat moss) and selected as much as possible with the same length and number of leaves and each pot contained one seedling. The experiment included 16 treatments, which were a combination of four levels of salt stress, yeast treatments, and *Spirulina platensis* The different treatments can be summarized as follows in Table (1).

Preparation of *Spirulina platensis* extract

By dissolving 500 mg tablet in 5 liters of distilled water and then dividing it into 5 packages, each package contains 100 mg of *Spirulina platensis /* liter of distilled water.

Table (1): The different experimental treatments used in the experiment.

Salinity mg NaCl/L	**Agents (yeast and *Spirulina platensis* extract)**
S_0	Irrigation only with tap water (S_0) spraying with yeast extract (Y) spraying with *Spirulina platensis* extract (SP) spraying with yeast extract + *Spirulina platensis* extract (Y+SP)
S_1 (1000 mg NaCl/L)	1000 mg NaCl/L. (S_1) 1000 mg NaCl/L + spraying with yeast extract (S_1+Y) 1000 mg NaCl/L.+ spraying with *Spirulina platensis* extract (S_1+SP) 1000 mg NaCl / L+ spraying with yeast extract + *Spirulina platensis* extract (S_1+Y+SP)
S_2 (2000 mg NaCl/L)	2000 mg NaCl/L (S_2) 2000 mg NaCl/L+ spraying with yeast extract (S_2+Y) 2000 mg NaCl + spraying with *Spirulina platensis* extract (S_2+SP) 2000 mg NaCl / L+ spraying with yeast extract + *Spirulina platensis* extract (S_2+Y+SP)
S_4 (4000 mg NaCl/L)	4000 mg NaCl/L (S_4) 4000 mg NaCl + spraying with yeast extract (S_4+Y) 4000 mg NaCl/L+ spraying with *Spirulina platensis* extract (S_4+SP) 4000 mg NaCl / L+ spraying with yeast extract + *Spirulina platensis* extract (S_4+Y+SP)

Three weeks after transplanting salt stress conditions e.g. Control (S_0) (without NaCl), 1000 (S_1), 2000 (S_2), and 4000 (S_4) mg NaCl/L. The agents used were yeast extract (Y) at the rate of 2 g/L water and *Spirulina platensis* extract (SP) at the rate (100 mg/L), yeast and *Spirulina platensis* extract were applied alone or interacted and it was sprayed on the plants twice a week.

Preparation of yeast extract

2 g of instant yeast (Victoria) was dissolved in 1 liter of warm distilled water with 1 g of sugar and placed in the incubator at 25 °C for 2 h to activate the yeast (Marhoon *et al.*, 2018). Yeast was used at a concentration of 2 g/ L of water.

The experimental design was factorial "two-ways" in randomized complete blocks with five replications. Salinity supply levels were considered as the first factor, while the yeast, *Spirulina platensis* extract, and its combination were considered as the second factor.

Weed and pest control as well as other agricultural practices were done whenever necessary. After two months of treatment, three plants were randomly and carefully taken from each treatment, and after washing the roots the plants were transferred to the laboratory for study:

Chemical properties:

1. Photosynthetic pigments

Chlorophyll content was estimated in fresh leaves as described by Witham *et al.*, (1971).

2. Antioxidant enzyme activity

a) **Peroxidase activity*:*** Measured after 2 min in fresh weighted leaves using the method described by Fehrmann and Dimond, (1967).

b) **Polyphenol oxidase activity*:*** Measured after 45 min in fresh weighted leaves that were extracted according to Hammad and Ali, (2014).

3- Proline and Protein

Proline was estimated according to the methods described by Bates *et al.* (1973). Protein concentration was estimated according to the methods described by Rosen (1957).

4. Statistical analysis

Data were statistically analyzed using SAS Software version 9.2 (SAS Institute,2008). To analyze variance tests (ANOVA). From differences between the three main factors salinity stress level, yeast, and spirulina extract, orthogonal comparisons were performed using Duncan's New Multiple Range Test at a 5 % significance level.

Result

1- Photosynthetic pigments concentration

The results in Table (2) showed a significant decrease in the content of photosynthetic pigments (chlorophyll a and b and carotene) for salinity treatments and a substantial increase for the rest of the treatments studied. The best results were obtained by treating Y, SP, and Y+SP at all salt concentrations.

Table (2): Effect of salinity levels and foliar spraying with yeast and *Spirulina platensis* and their interaction on the photosynthetic pigments in tomato plants (*Solanum Lycopersicon*).

Photosynthetic pigments (mg g^{-1} fr.wt)												
Characters	Chl a				Chl b				Carotenoids			
Agents (A) Salt supply	Without	Y	SP	Y+SP	Without	Y	SP	Y+SP	Without	Y	SP	Y+SP
S0	0.38^{ef}	0.61^{d}	0.51^{e}	0.41^{g}	0.29^{e}	0.43^{c}	0.36d	0.31^{e}	0.62^{ij}	0.96^{c}	0.87^{e}	0.80^{f}
S1	0.39^{a}	0.74^{b}	0.63^{d}	0.42^{g}	0.28^{e}	0.51^{a}	0.50^{ab}	0.37^{d}	0.64^{i}	1.003^{b}	0.98^{bc}	0.68^{h}
S2	0.37^{h}	0.65^{c}	0.59^{d}	0.40^{g}	0.25^{g}	0.47^{b}	0.37^{d}	0.36^{d}	0.59^{j}	0.97^{d}	0.89^{de}	0.87^{e}
S4	0.36^{h}	0.71^{e}	0.51^{e}	0.37^{h}	0.21^{f}	0.46^{f}	0.40^{f}	0.24^{g}	0.55^{L}	0.98^{g}	0.87^{e}	0.72^{a}

S_0 Without salt, S_1(1000 mg NaCl/L), S_2(2000 mg NaCl/L), S_4(4000 mg NaCl/L), Y (yeast extract 2 g/L water), SP (*Spirulina platensis* extract 100 mg/L) and Y+SP (Yeast 2 g/L water + *Spirulina platensis* extract 100 mg/L).

2- Antioxidant enzyme activity

The results obtained in Table (3) showed that spraying with yeast and algae extract and the interaction between them led to a significant increase in the content of POD and PPO enzymes in all studied treatments compared to salt-only treatments. The highest values for the POD (74.07) and PPO (31.08) enzymes were obtained from the Y+ SP +S_4 treatment.

Table (3): Effect of salinity levels, foliar spraying with yeast and *Spirulina platensis* and their interaction on the activity of (POD and PPO) in tomato plants (*Solanum Lycopersicon*).

Antioxidant enzyme activity (µ min^{-1} g fr. wt)								
Characters	Peroxidase (POD)				Polyphenol oxidase (PPO)			
Agents (A) Salt supply	Without	Y	SP	Y+SP	Without	Y	SP	Y+SP
S0	40.94^{j}	51.89^{f}	45.14^{h}	50.53^{g}	11.09^{h}	13.82^{g}	17.09^{e}	16.84^{e}
S_1	43.62^{i}	58.19^{d}	47.94^{i}	57.20^{e}	14.24^{fg}	18.96^{d}	24.92^{f}	21.03^{c}
S_2	50.59^{g}	62.75^{c}	51.12^{j}	63.50^{c}	19.89^{d}	27.19^{b}	24.59^{fg}	27.08^{b}
S_4	35.09^{e}	66.46^{b}	49.63^{k}	74.07^{a}	21.19^{h}	31.04^{a}	27.08^{b}	31.08^{a}

S_0 Without salt, S_1(1000 mg NaCl/L), S_2(2000 mg NaCl/L), S_4(4000 mg NaCl/L), Y (yeast extract 2 g/L water), SP (*Spirulina platensis* extract 100 mg/L) and Y+SP (Yeast 2 g/L water + *Spirulina platensis* extract 100 mg/L).

3- Protein and Proline concentration:

In general, the results in Table (4) showed a significant increase in protein concentration in all treatments Compared to salt treatments + S_2 and Y + S_2 treatments showed a highly significant increase compared to all treatments.

It is obvious from Table (4) and Figure (3) that all treatments led to a significant increase in proline concentration, except for the yeast treatments. The highest increase in proline concentration was in the treatment Y + SP +S_2 followed by SP+ S_2.

Table (4): Effect of salinity levels, foliar spraying with yeast and *Spirulina platensis* and their interaction on protein and proline content in tomato plants *(Solanum Lycopersicon)*.

Characters	Protein (mg g^{-1} fr. wt.)				Proline (mg g^{-1} dry wt.)			
Agents(A) Salt supply	Without	Y	SP	Y+SP	Without	Y	SP	Y+SP
S0	20.01^{i}	20.59^{hi}	21.34^{h}	23.34^{fg}	53.68^{cd}	35.04^{e}	54.31^{cd}	50.52^{d}
S_1	23.40^{efg}	25.81^{c}	22.65^{g}	24.70^{d}	57.03^{bcd}	26.12^{abc}	56.97^{bcd}	60.31^{bcd}
S_2	19.63^{i}	26.86^{b}	29.54^{a}	25.84^{c}	59.44^{bcd}	18.12^{a}	64.97^{bc}	67.33^{ab}
S_4	19.65^{i}	24.48^{d}	24.08^{def}	24.39^{de}	59.11^{bcd}	24.47^{cd}	64.69^{bc}	60.19^{bcd}

S_0 Without salt, S_1(1000 mg NaCl / L), S_2(2000 mg NaCl / L), S_4(4000 mg NaCl / L), Y (yeast extract 2 g/L water), SP (*Spirulina platensis* extract 100 mg/L) and Y+SP (Yeast 2 g/L water + Spirulina platensis extract 100 mg/L).

Discussion

Tomatoes are important vegetables globally due to their numerous health-promoting components (Abdel-Mageed et al., 2018). Biotic and abiotic stresses affect tomato growth and physiology (Zhu, 2002). The most important abiotic stress is salt stress, which is an increase in the concentration of salt that leads to an increase in the flow of ions from the external environment of the cell on the one hand and the loss of water by osmosis on the other hand (Lemekeddem and Debbache, 2014)

The survival of tomato plants depends on their ability to synthesize organic compounds such as proline to reduce the damage caused by salt stress (Borsani *et al.,* 2003). The results in Table (1) showed an increase in proline under salt stress because proline works to regulate the osmotic regulation of the cell and maintain cell proteins by regulating nitrogen storage, reducing protein breakdown, and protecting enzymes from damage caused by salt stress (Pessarakli, 1999). Proline accumulation may reach twice the amount present in the tissues. The increase in proline content is a protective response of the plant to all factors affecting it that lead to a decrease in water in the cytoplasm (Hamdoud, 2012). Proline accumulation is considered one of the most important indicators used to show the extent to which the plant is affected by salt stress (Martinez *et al.,* 1996). Proline also plays an important role in reducing stress caused by salinity. By removing reactive oxygen species (Abdelmoteleb *et al.,* 2022), plants under salt stress tend to form proline to reduce the toxic damage of ammonia, and proline formation increases to counteract the toxic effect of ammonia (Levitt,1980).

The use of a foliar spray of yeast extract led to a decrease in proline. This decrease may be due to the presence of amino acids, sugars, gibberellins, and IAA in the yeast extract, which act as a substitute for proline and regulate physiological processes in salt-stressed plants (Taha *et al.,* 2021). It is consistent with what was stated by El-Shawa *et al.,* 2020 that the use of yeast led to a decrease in proline in Calendula *(Calendula officinalis* L.*).* The use of cyanobacteria has an important role in alleviating salinity stress and activating the plant to absorb nutrients. These results are similar to the results of (Abdelmoteleb *et al.,* 2022) when applying cyanobacteria to salt-stressed tomato plants.

Cyanobacteria led to the accumulation of Ca^{+2}, which contributes to osmotic regulation by increasing water absorption and proline content, thus increasing the plant's tolerance to salinity. It is also similar to what was stated by (Abdelaziz *et al.,* 2022) that the use of foliar spray with cyanobacteria increased the proline content in pepper plants.

High concentrations of salt led to a decrease in protein content. This is due to the negative effect of salinity on the roots by reducing water absorption and ion absorption (nitrate ion and chloride ion in the cell (Zheng *et al.,* 2009), which is consistent with what was stated by (Debouba *et al.,* 2007) that high salinity affects the activity of the enzyme Nitrate reductase, which is responsible for reducing nitrate absorbed by the plant to nitrite, then ammonia, then amino acids, then protein.

Low salt concentrations increased protein due to decreased salinity-induced protein degradation, leading to slower utilization of reserve protein rather than activating protein synthesis (Kasim *et al.,* 2016). This is consistent with the finding of (Sibole *et al.,* 2003) that treatment of alfalfa (Medicago *citrna L.)* with concentrations of sodium chloride resulted in increased protein content compared to the control group.

Using foliar spraying of yeast led to an increase in protein due to the yeast extract containing major and minor elements and plant hormones that work to increase cell division, which leads to a balance in physiological processes, activating photosynthesis, increasing proteins, and enhancing growth properties (El-Shraiy *et al.,* 2016). This is consistent with what was mentioned by (Agamy *et al.,* 2013) that there is an increase in proteins and sugars when using foliar spraying of yeast on sugar beet plants.

The application of Spirulina platensis enhanced the protein content in salt-stressed tomato plants by mitigating sodium levels and augmenting soil fertility through elevated potassium and nitrogen, thereby promoting mineral elements and protein synthesis (Taha et al., 2023). The results are similar to those mentioned by Hamouda et al. (2022) in that the use of Spirulina platensis increased the protein content because it contains amino acids and zinc.

Chlorophyll is the basic substance for the photosynthesis process, is found in plants and algae, gives them a green color, and allows them to absorb light in the photosynthesis process (Mostafa *et al.,* 2024). From the results presented in Table (2) it is clear that there is an inverse relationship between salt concentrations and the amount of chlorophyll, the more salinity increases, the amount of chlorophyll decreases due to the decrease in leaf area and the decrease in the water potential of the leaf, which causes a decrease in energy production during the photosynthesis process and the closure of the stomata as a result of the filling pressure in the guard cells, as well as leads to a decrease in CO_2, in agreement with what was stated by (Selem, 2019) that salt stress works to reduce chlorophyll in the bean plant. Salinity also leads to an increase in the activity of the enzyme Chlorophyllase (the enzyme that decomposes chlorophyll), thus reducing the amount of chlorophyll (Levitt, 1980). Similar results were obtained by (Osman, *et al.,* 2021) on the bean plant Soybeans. Salinity degrades photosynthetic pigments (chlorophyll and carotenoids) and grana membranes in chloroplasts due to excessive production of ROS (Eraslan *et al.,* 2008).

The use of yeast led to an increase in the number of photosynthetic pigments due to the role of yeast in cell division and elongation, which increases the leaf area of the plant (Ismail and Amin, 2014) and because yeast contains cytokinin that delay leaf aging by reducing chlorophyll decomposition and increasing protein and RNA synthesis. It is consistent with what was mentioned by (Medan *et al.,* 2021) that yeast contains large amounts of proteins, carbohydrates, and vitamins that work to increase the physiological processes in the plant and improve vegetative growth and the plant's chlorophyll content, thus increasing the rates of photosynthesis and yeast containing hormones such as auxins, gibberellins and cytokinin's that play an important role in transporting the products of photosynthesis to the vegetative parts. In addition, the use of foliar spraying of yeast led to an increase in carotenoids. These results are similar to the results of (Taha *et al.*, 2021) on the Lupinus term plant and the results of (El-Shawa *et al.*, 2020). The use of Spirulina platensis increased the chlorophyll content in salt-stressed tomato plants due to its effect on cell membrane permeability by increasing cell membrane permeability and enhancing nutrient absorption and its role in delaying leaf aging by reducing chlorophyll decomposition. Similar to the results of (Jimenez *et al.,* 2020) on tomato plants. Also, Spirulina platensis extract contains growth hormones, vitamins, amino acids, and mineral elements responsible for increasing chlorophyll and thus improving plant productivity (Mostafa *et al.*, 2024). The reason for the increase in chlorophyll in tomato plants may be due to the increased absorption of nitrogen by cyanobacteria and then its transfer to plant tissues. Also, the use of cyanobacteria led to a decrease in ethylene production and stimulated the formation of carotenoids that protect chlorophyll from oxidation and increase its content (Abdelaziz *et al.*, 2022).

Exposure of tomato plants to salt stress is associated with increased antioxidant activity (peroxidase enzyme POD and polyphenol oxidase enzyme PPO) due to the role of these enzymes in eliminating reactive oxygen species toxins such as hydrogen peroxide and thus protecting the plant from oxidative stress (El-Shawa *et al.,* 2020). Similar to the results of (Cia *et al.,* 2012) on sugarcane plants. (ROS) increases under salt stress due to the harmful effect of salt stress that causes damage to mitochondria and chloroplasts. It is consistent with what was stated by (El-Shawa *et al.*, 2020) that ROS increases in *Calendula (Calendula officinalis L.)* plants under salt stress.

The use of yeast extract increased the content of the enzyme (POD and PPO) because yeast contains large amounts of minerals (chromium and zinc) that work to enhance antioxidants (Emam,2013).

It is consistent with what was mentioned by (El-Shawa *et al.*, 2020) when using yeast extract and proline on Calendula (Calendula officinalis L.), it improved the activity of antioxidants (POD and PPO) and reduced ROS levels. These results are similar to the results of (Yan *et al.*, 2016) when using yeast on salt-stressed sweet potato plants.

The use of cyanobacteria also increased the content of tomato plants of the enzyme (POD) and the enzyme (PPO), which are among the most important enzymes that work to increase the plant's resistance to stress (Abdelaziz *et al.*, 2022).

The antioxidant enzymes worked to convert hydrogen peroxide into water and oxygen, which are non-toxic compounds, which lead to protecting cell membranes from stress (Alharbi *et al.*, 2023).

Conclusion

Yeast extract (2 g/L distilled water) and *Spirulina platensis* extract (100 mg/L distilled water) have been shown to reduce salt stress in tomato plants. These procedures are both safe and affordable. The best therapy for reducing the effect of salinity and increasing tomato plant resistance to salinity is yeast treatment, followed by spirulina algae treatment, and then yeast + spirulina algae treatment.

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تأثير الرش الورقي بمستخلص الخميرة وطحلب السبيرولينا على تحمل الملوحة في نبات الطماطم

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الملخص العربى

يمكن أن يساهم الري بالمياه المالحة فى تخفيف نقص موارد المياه العذبة الزراعية، وخاصة في المناطق القاحلة. تستعمر الخميرة بسرعة أسطح النباتات، وتستخدم العناصر الغذائية من العديد من المصادر، وتظل على قيد الحياة في نطاق واسع نسبيًا من درجات الحرارة، ولا تنتج أي نواتج أيضية ضارة ولا يكون لها آثار ضارة على المنتج الغذائي النهائي. تحتوي مستخلصات الطحالب على سلسلة من المركبات النشطة بيولوجيًا، بالإضافة إلى العناصر الغذائية المعدنية والعضوية، وبالتالي يمكن استخدام مستخلصات الطحالب كمحفزات حيوية للنباتات نظرًا لقدرتها على تعزيز نمو النباتات في ظروف دون المستوى الأمثل مثل البيئات المالحة. في هذا السياق، تهدف الدراسة الحالية إلى تقييم الرش الورقي لمستخلص الخميرة وطحالب سبيرولينا بمفردها أو معًا كاستراتيجية للتخفيف من الآثار الضارة للملوحة على نمو نبات الطماطم (*Solanum lycopersicon*). أجريت التجربة العاملية بتصميم قطاعات كاملة العشوائية تضمنت أربعة مستويات من ملوحة الماء (٠، ١٠٠٠، ٢٠٠٠، و٤٠٠٠ ملغم/لتر ماء) والرش الورقى بتركيز واحد من مستخلص الخميرة ومستخلص طحلب سبيرولينا (٢ جرام خميرة، ١٠٠ ملغم/لتر ماء) على التوالي. وبشكل عام أظهرت النتائج زيادة في محتوى البرولين وإنزيم البيروكسيديز والفينول اكسيديز في حين انخفض تركيز البروتين والأصباغ الضوئية في النباتات تحت ضغط الملح. من ناحية أخرى، لوحظت زيادة في الصفات المدروسة عند المعالجة بالخميرة وطحلب سبيرولينا بينما أظهرت المعالجة بالخميرة انخفاضًا في تركيز البرولين. أدى استخدام الرش الورقي بالخميرة والطحلب إلى جعل نباتات الطماطم متسامحة مع ضغط الملح وقلل من سلبيته. تشير النتائج إلى أدوار فعالة لمستخلص الخميرة وطحلب سبيرولينا في إدارة الآثار الضارة الناجمة عن الملح في نباتات الطماطم الهامة اقتصاديًا. ويوصي البحث باستخدام مستخلص الخميرة بتركيز (٢جرام/لتر) وكذلك ومستخلص طحلب سبيرولينا (١٠٠ ملجم/لتر) لتحسين نمو نباتات الطماطم النامية تحت ظروف الملوحة. وهي مواد أمنة وكذلك غير مكلفة. وقد أظهرت معاملة النباتات بمستخلص الخميرة مقاومة عالية للملوحة يليها مستخلص طحلب سبيرولينا.

الكلمات المفتاحية: الملوحة، الطماطم (*Solanum lycopersicon*) ، مستخلص الخميرة، مستخلص *Spirulina platensis*، البرولين، نشاط الإنزيمات.