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Growth Characteristics Influence of Beans by spraying with Salicylic acid and zinc

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ABSTRACT

An experiment was conducted at the Research field Station of the Field Crops Department - College of Agriculture - University of Tikrit for the winter season of 2023-2024, to study the influence of spraying salicylic acid and zinc on beans (*Vicia faba* L.) growth. The factors of the experiment included spraying the bean plants with salicylic acid with a concentration level of 100, and 150 mg L-1 and control treatment. The second treatment factor was spraying with zinc at a concentration level of 100 mg L-1 and the control treatment. The experiment design was applied according to the complete randomized block design system with three replicates, and the averages were compared according to Duncan's multiple-nominal test at a probability level of 0.05. outcomes appear that the spray treatments with salicylic acid 100 and 150 mg L-1 did not significantly different in all studied traits except for the trait of plant height and leaf area, in which the concentration level exceeded 150 mg L-1, and reached 3.93 cm, 2252.17 cm2 per plant, respectively. As for the spray treatment with zinc at a concentration level of 100 mg L-1, it was significantly superior in the traits of plant height, number of branches, number of leaves, leaf area, and leaf content of chlorophyll, and reached 49.11 cm, 4.93 branch plant-1, 37.96 leaf plant-1, 2352.44 cm2 plant-1, 48.16 spad, respectively. As for the two-way interaction, the spray treatment with salicylic acid at 150 mg L-1 and the spray treatment with zinc at 100 mg L-1 were superior. In the traits of plant height, number of branches, number of leaves and leaf area, and leaf content of chlorophyll, they reached 52.36 cm, 5.90 branch plant-1, 41.46 leaves plant-1, 2969.00 cm2 plant-1, 51.00 spad respectively, while the lowest averages were recorded for the control treatment. the interaction between the spray treatments with salicylic acid and zinc 150 mg L-1 recorded the highest average for the traits, amounting to 52.63 cm for the Plant height, 2969.00 cm2 for leaf area, and 51.00. SPAD average of chlorophyll, 41.46 leaves for the number of leaves trait, and 5.90, branch for number of branches per plant.

تأثير الرش بحامض السالسليك وعنصر الزنك في بعض صفات النمو الخضرية لنبات الباقلاء

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الخلاصة

نفذت تجربة حقلية في محطة الابحاث التابعة لقسم المحاصيل الزراعية ـــ كلية الزراعة ـــ جامعة تكريت للموسم الشتوي 2024 - 2023، بهدف دراسة تأثير الرش بحامض السالسليك وعنصر الزنك في نمو نبات الباقلاء وتضمنت التجربة عاملين الاول الرش بحامض السالسليك بتركيز (100 ، 150) ملغم لتر$^{-1}$ و معاملة المقارنة اما العامل الثاني هو الرش بعنصر الزنك بتركيز (100) ملغم لتر $^{-1}$ومعاملة المقارنة. وكان تصميم التجربة وفق نظام القطاعات العشوائية الكاملة بثلاث مكررات وقورنت المتوسطات وفقاً لاختبار دنكن متعدد الحدود تحت مستوى احتمال . 05.0اظهرت النتائج ان معاملات الرش بحامض السالسليك 100 و150 ملغم لتر$^{-1}$ لم تختلف معنوياً في جميع الصفات المدروسة عدا صفة ارتفاع النبات والمساحة الورقية التي تفوق فيها التركيز 150 ملغم لتر$^{-1}$ وبلغت 3.93 سم، 2252.17 سم^{2} نبات$^{-1}$ على التوالي اما بالسنبة لمعاملة الرش بعنصر الزنك بالتركيز 100 ملغم لتر$^{-1}$ فقد تفوقت معنوياً في صفات ارتفاع النبات، عدد التفرعات، عدد الاوراق ،المساحة الورقية، محتوى الاوراق من الكلوروفيل، وبلغت على التوالي 49.11سم، 4.93 فرع نبات$^{-1}$، 37.96 ورقة نبات$^{-1}$، 2352.44 سم^{2} نبات$^{-1}$، 48.16 Spad،.بالنسبة للتداخل الثنائي فتفوقت معاملة الرش بحامض السالسليك بالتركيز 150 ملغم لتر$^{-1}$ والرش بعنصر الزنك بتركيز 100 ملغم لتر$^{-1}$ في صفات ارتفاع النبات، عدد التفرعات، عدد الاوراق والمساحة الورقية ، محتوى الاوراق من الكلوروفيل، وبلغت على التوالي 52.36 سم، 5.90 فرع نبات$^{-1}$، 41.46 ورقة نبات$^{-1}$،2969.00 سم^{2} نبات $^{-1}$، 51.00 Spad على التوالي، بينما كانت اقل المتوسطات المسجلة لمعاملة المقارنة.

الكلمات المفتاحية: حامض السالسليك , عنصر الزنك, التسميد ، التغذية الورقية، النمو الخضري، الباقلاء .

INTRODUCTION:

Bean (*Vicia Faba* L.) is one of the important crops known to man since ancient times. The original homeland of the bean is not known precisely, as many scholars disagree about that. Some of them mentioned that the bean's origin is West Asia, while others mentioned that it is Central Asia. Its cultivation spread in the third decade before birth in some regions of the Mediterranean. Bean was an important food crop to the ancient Egyptians, Greeks, Babylonians, and Romans. The bean crop is considered one of the most important and strategic seed crops in Iraq, and it belongs to the leguminous family, which is produced inside the green pods It consists of protein, carbohydrates, and several mineral elements that are characterized by high productivity and in different percentages depending on the varieties (31.83) % protein, (54.60) % carbohydrates, (3.47) % ash. (1.24) % fat, (11.96) % fiber. It also contains sugars and many amino acids such as aspartic, ascorbic, glycine, proline, and others. Beans are used as animal feed in addition to their ability to Improve soil properties by fixing nitrogen through root nodules in symbiosis with Rhizobium bacteria (Ray et al., 2015).

Bean plants are affected by several factors, including salinity, humidity, and high and low temperatures. They are also affected by agricultural factors such as the date and methods of planting, fertilization, and the planting season. Foliar feeding is one of the most important modern methods of feeding plants. This is done by spraying liquid fertilizers directly on the leaves, as the liquid fertilizers are absorbed through the stomata. These fertilizers or the main nutrients can be added when there is not enough moisture in the upper layers of the leaves. Soil. Recently, this method has been used as an essential part of crop production (Patil and Chetan, 2018). Salicylic acid is one of the most important growth regulators derived from phenols and has many functions that play a role in many physiological processes in plants. It works to regulate growth also involved in regulating the processes of cellular metabolism, and carbon synthesis in addition to protein synthesis. It also has an important role. In closing the stomata and gas exchange. It also has a defensive role in protecting the plant by resisting biotic and abiotic stresses and protecting against various diseases. It also helps in absorbing nutrients and transporting them within the parts of the plant (Arif et al., 2020). Rathore et al. (2022) showed in research using spray salicylic acid at three levels of concentration (100, 150, 200) mg L-1 in addition to Comparative treatment Spraying with salicylic acid at a concentration of 200 mg L-1 caused a significant increase in the traits of plant height, number of branches, number of days for 50% of the flowers to open, pod length, pod width, and number of pods. on the plant and the number of seeds in the soil, which amounted to 98.7 cm,

5.3 plant branches - 1, 65.3 days, 6.93 cm, 1.18 cm, 72.2 Plant pod-1, 3.57 plant seed-1 respectively, While the lowest averages were in the control treatment and amounted to 92.1 cm, 4.9 plant branches-1, 69.6 days, 6.45 cm, 1.05 cm, 55.6 plant pod-1, 3.0 plant seed-1, respectively. Many studies have indicated the salicylic influence on plant growth and yield, including those conducted by Hadayat et al. (2023) Spraying salicylic acid at three levels of concentration (100, 200, 300) mg L-1 to pea plants.

The concentration of 300 mg L-1 had a significant effect on plant height, number of branches, minimum number of days for flowering, number of pods, total number of seeds, and chlorophyll content of leaves, which amounted to 71.85 cm. 3.25 plant branch-1, 5.26 days, 11.05 century-1, 55.81 spad, respectively. Atab and others (2023) showed that spraying with salicylic acid at two concentrations, 100 and 200 mg L-1, affected the physiological and enzymatic properties of three types of beans. The concentration of 200 mg L-1 significantly improved the chlorophyll content of the leaves, which reached 24.23 mg, and the seed yield, which amounted to 2.40 plant seeds-1, compared to the control treatment. Which amounted to 18.03 mg L-1 and 1.56 tons ha, respectively.

Zinc is one of the most important micronutrients necessary for most crops, as it works to improve the process of photosynthesis and metabolic activity, in addition to its important role in the formation of the amino acid that forms the hormone indole acetic acid (IAA), which works on elongation and division. Cells also have a role in increasing the composition of the dry matter percentage of the plant through the construction of protein and nuclear acids, DNA, and RNA (Zafar et al., 2020). Many studies have shown the effect of boron on plant growth and yield, including, for example, Yousefi et al. (2023) in a study to determine the effect of foliar spraying with zinc on the production of bean seeds (*Phaseolus vulgaris* L.) and its components, which was experimented was conducted at the Rice Research Institute in Iran with four concentrations of zinc (0.2, 0.3, 0.4) % sprayed on the shoots in two stages. Flowering stage and pod formation stage. Foliar spraying with zinc at concentrations of 0.3 and 0.4% had a significant effect on the traits of plant height, length of pods, number of seeds per pod, weight of 100 seeds, and total yield as measured. With a control treatment, Anchra et al. (2024) found from an experiment that the effect of adding zinc (0.5%) as a spray on the shoots on the growth, yield, and absorption of nutrients in lentils (*Lens Culinaris* L.) In semi-humid areas, spraying with zinc caused an increase in the traits of seed yield to the maximum amounting to (1.76) tons per hectare.

It also caused an increase in the content of nutrients such as nitrogen, phosphorus, potassium, and zinc in addition. To increase the spray content compared to the treatment Rehman and others (2024) observed that using zinc to improve lentil yield by foliar spraying at a concentration of (0.5)% after (50) days and (100) days from Seeds, spraying with zinc after (100) days caused a significant increase in days to flowering, which reached (110) days, and number of days to maturity, which reached (159)%, number of nodules on the plant (22) The doctrine of plants-1, The number of branches is (8) branch plant-1, and the height of the plant is (58) cm compared to the treatment (112) days, (165) days for maturity, (17) plant nodules-1,(4) plant branch-1,(4) cm, respectively. Therefore, this study aimed to determine the most effective level of salicylic acid concentration on the vegetative growth traits and yield of beans. Determining the effect of foliar spraying of zinc on the vegetative and productive traits of beans in gypsum soil.

MATERIALS AND METHODS

1-Location of the experiment: An experiment was carried out at the research field station of the Field Crops Department at the College of Agriculture - University of Tikrit for the spring agricultural season 2023-2024 to study the influence of spraying of Salicylic acid and zinc in some growth traits of beans. Below is a table of the experiment soil analysis.

status	Quantity	unit
E.C.	2.65	m.s.
pH	7.47	----
Gypsum	18	%
Lime	23	%

Organic matter	**0.8**	**%**
sand	**52**	**%**
silt	**36**	**%**
clay	**12**	**%**
Texture	**loam**	**----**

2 - Preparing experiment site: The necessary plowing, smoothing, and leveling operations were carried out for the experiment site, to prepare the land for agriculture, and chemical fertilizers were added according to recommendations before planting. Three sectors were created according to the experiment plan, and each sector was divided into 6 Experimental units with four lines, 40 cm between rows, and the distance between plants was 15 cm. Area of the experimental unit was 2 m2, then a space of 1 m was left between replication.

3- Seeding of French beans (Morong) was planted during the fall of 2023-2024. They were placed deep inside the hole (5) cm and each pod contained 2 seeds

4- Crop servicing operations: The servicing process was carried out for the crop by manual hoeing to get rid of weeds and brush following the recommendations followed in growing beans until all stages of growth were completed, and irrigation was carried out as needed by using well water. Operations were also carried out Thinning and patchwork.

Experiment design :

A factorial experiment was conducted according to a randomized complete block design (RCBD) with three replications and 6 experimental units per sector. Treatments were randomly distributed among the experimental units in the replications.

Experimental factors: The experiment studied two factors: The first factor was Spraying bean plants with salicylic acid at two concentrations (100, 150) mg L-1 and the control treatment.The second factor was spraying zinc at a concentration of (100) mg L-1 and the control treatment. Zinc was sprayed when two leaves appeared on the plant. And with salicylic acid ten days after.

Studied traits:

1. Plant height (cm): Plant height was calculated from the soil surface level to the growing tip using a tape measure for five plants from the middle lines of each plant. An experimental unit and take its average.
2. Leaf area (cm2 of plant-1): The leaf area was calculated according to the Scanner method and the Imagej program installed on the computer device described by (Sadik et al., 2011), by taking 5 leaves from five plants from the same location on the plant and randomly from the middle lines of the experimental unit, and the program's reading rate of the leaves was multiplied the average number of leaves and the leaf area was extracted.
3. Total chlorophyll content (SPAD). The chlorophyll content of leaves was measured using the SPAD device. The measurements of 5 leaves of five plants that were taken from the experimental unit were taken randomly from the middle lines and their average was calculated.
4. Number of leaves (leaf plant-1): The total number of leaves for five plants from each experimental unit was calculated randomly from the middle lines. The rate was calculated for an individual plant.
5. Number of branches (branch plant-1): The average trait was calculated by taking five plants from the experimental unit randomly from the middle lines and their average was calculated. For a single plant...

Statistical analysis: The studied traits were analyzed by computer using the Statistical Analysis System (SAS Institute, 1996) program, and the Duncan coefficient test was used at the 0.05 probability level. To test the significant differences between the arithmetic averages of the transactions

RESULTS AND DISCUSSION:

1- Plant height (cm).

Table (1) The effect of spraying with salicylic acid and zinc on the height of bean plants (cm)

Zinc concentration mg l^{-1}	Concentration of salicylic acid, mg L^{-1}			Zinc element average
	0	100	150	
0	40.13 e	45.36 cd	43.50 d	43.00 b
100	46.13 bc	48.56 b	52.63 a	49.11 a
Salicylic acid average	43.13 b	46.96 a	48.06 a	

*Similar letters indicate that there is no significant difference at the 0.05 probability level.

Table (1), it is noted significant differences between the treatments, as the results of the table indicate that there are significant differences between the spraying treatments with salicylic acid at the concentration level of 100 mg L-1 and 150 mg L-1 respectively, as the highest average of the characteristic was recorded at a concentration of 150 mg L-1 amounting to 48.06 cm and 46.96 mg L-1 For the control treatment, which recorded the lowest average for the trait, 43.13 cm, with a difference of . The reason for this may be due to the role of salicylic in the process of rapid cell division and elongation due to the synergism between phenol and auxin, as well as to the effect of salicylic acid in enhancing chemical reactions as it accelerates the divisions that occur in the apical part of the shoots. (Hussien et al., 2011). The same table results show that zinc spray treatment at a concentration level of 100 mg L-1 is significantly superior. The highest average for the trait was 49.11 cm compared to the control treatment, which recorded the lowest average for the characteristic 43.00 cm, a difference of 14.2%. The reason for this may be attributed to the role of zinc in improving and increasing the products of the photosynthesis process due to its effect in activating some enzymes that have an important role in cell division and elongation, as they work to increase stem height as a result of its role in increasing plant growth regulators (Seifinadergholi, 2011). The statistical analysis table (1) indicates a significant difference in the interaction between the spray treatments with salicylic acid and zinc at the two concentrations: 150 mg L-1100 mg L-1 It recorded the highest average for the trait, amounting to 52.63 cm, compared to the control treatment, which recorded the lowest average for the characteristic, 40.13 cm, a difference of 13.14%.

Table (2) The effect of spraying with salicylic acid and zinc on the leaf area (cm^2)

Zinc concentration mg l^{-1}	Concentration of salicylic acid, mg L^{-1}			Zinc element average
	0	100	150	
0	1071.00 e	1255.33 d	1535.33 c	1287.22 b
100	1696.00 c	2392.33 b	2969.00 a	2352.44 a
Salicylic acid average	1383.50 c	1823.83 b	2252.17 a	

*Similar letters indicate that there is no significant difference at the 0.05 probability level.

Table (2) indicate that there is a significant difference between the spraying treatments with salicylic acid, as the highest average of the characteristic was recorded at the concentration of 150 mg L-1, amounting to 2252.17 cm2. The control treatment recorded the lowest average for the trait, amounting to 1383.83 cm2, a difference of 62.7%. Salicylic acid has a high ability to improve the efficiency of the photosynthesis process as a result of stimulating the process of assimilation of proteins and increasing the efficiency of carbohydrates, which increases the height of the plant and number of branches, which was reflected positively in increasing the number of leaves and leaf area (Padmapriya and Chezhiyan, 2002). The reason for the increase in the number of leaves may be due to the increase in growth and the number of branches, which increased the number of leaves, which was reflected positively in the increase in the total leaf area. These results are consistent with the findings of (Teixeira et al., 2004 and Bozorgi et al., 2011), Which was reflected in an increase in vegetative growth and the role of salicylic acid as an important factor in the processes of

photosynthesis, respiration, and biochemical and physiological processes combined to increase the total yield of the plant (Rietra et al., 2017 and Khan et al., 2022). Table (2) indicates that the spraying treatment with zinc was significantly superior in leaf area (cm2) at the concentration of 100 mg L-1, as the highest average for the trait was recorded at 2352.44 cm2 comparing with the control treatment which recorded the lowest main of 1287.22 cm2, a difference of 82.75%. The reason for this may be attributed to the role of zinc in improving plant growth, increasing carbohydrates and proteins, increasing the delivery of nutrients to all parts of the plant, activating photo enzymes, transporting absorbed materials, and forming chlorophyll Movahhedy - Dehnavy et al., (2009). The statistical analysis table indicates that there is a significant difference between spraying salicylic acid treatments and zinc at a concentration level of 150 mg L-1 and 100 mg L-1, the highest average for the characteristic reached 2969.00 cm2 for control treatment, which reached the lowest average of 1071.00 cm2, a difference of 177.2%.

3- Chlorophyll content in leaves (SPAD)

Table (3): The effect of spraying with salicylic acid and zinc on the chlorophyll content in the leaves(SPAD).

Zinc concentration mg l^{-1}	Concentration of salicylic acid, mg L^{-1}			Zinc element average
	0	100	150	
0	41.30 d	47.20 bc	47.23 bc	45.24 b
100	44.83 c	48.66 ab	51.00 a	48.16 a
Salicylic acid average	43.06 b	47.93 a	49.11 b	

*Similar letters indicate that there is no significant difference at the 0.05 probability level.

Table (3) regarding the chlorophyll content of leaves indicates that there is a significant difference between the treatments that were sprayed salicylic with a concentration level of 150 mg L-1 and 100 mg L-1. It recorded the highest average for the trait, amounting to 49.11 SPAD and 47.93 SPAD, respectively, while the control treatment recorded the lowest average, amounting to 43.06 SPAD, a difference of 14.05. %. These results are consistent with the findings of (Teixeira et al., 2004 and Bozorgi et al., 2011), The reason may be due to the role of salicylic acid in improving growth indicators through its role in improving the process of photosynthesis, preserving the enzymes involved in this process, permeability of plasma membranes, and increasing pigments (Al-Hilfy, 2017). From the same table, it was found that there was a significant difference between the treatments, as the spraying treatment with zinc recorded the highest average for the trait at a concentration of 100 mg L-1. Which amounted to 48.16 SPAD, while the lowest average for the control transaction was 45.24 SPAD, a difference of 6.45%. Zinc has a role in improving plant growth, activating photosynthetic enzymes, improving the process of photosynthesis, and transporting absorbed materials, which increases plant growth and thus the formation and activation of chlorophyll (Movahhedy - Dehnavy et al., 2009). The statistical analysis table indicates that there is a significant difference between spraying treatments with salicylic acid and zinc at concentrations of 150 mg L-1 and 100 mg L-1, as the highest average for the characteristic reached 51.00. SPAD, while the control treatment recorded the lowest average of 41.30 SPAD, a difference of 23.48%.

4. Number of leaves (leaf plant^{-1})

Table (4) The effect of spraying with salicylic acid and zinc on the number of leaves (leaf plant-1)

Zinc concentration mg l^{-1}	Concentration of salicylic acid, mg L^{-1}			Zinc element average
	0	100	150	
0	31.46 d	37.26 b	35.20 c	34.64 b
100	33.86 c	38.56 b	41.46 a	37.96 a
Salicylic acid average	32.66 b	37.91 a	38.33 a	

*Similar letters indicate that there is no significant difference at the 0.05 probability level.

Table (4) indicate that there is a significant difference in the number of leaves between the spray treatments with salicylic acid at concentrations of 100 mg L-1 and 150 mg L-1. It recorded the highest average of 38.33 leaf plant-1 and 37.91 leaf plant-1, respectively, which was significantly superior to the treatment of control, which recorded the lowest average of 32.66 leaves. A difference of 17.36%. As the study of Hussien et al. (2011) indicates Salicylic acid has a high ability to improve the efficiency of the photosynthesis process as a result of stimulating the process of assimilation of proteins and increasing the efficiency of carbohydrates, which increases the height of the plant and the number of branches, which was reflected positively in increasing the number of leaves and leaf area (Padmapriya and Chezhiyan, 2002).

It is also noted that the results of the statistical analysis of the same table show a significant difference between the spraying treatments with zinc at the concentration of 100 mg L-1. The highest average for the trait was recorded at 37.96 leaves, compared to the lowest average for the control treatment, which amounted to 34.64 leaves, a difference of 9.58%. The statistical analysis table indicates that there is a significant difference between spraying treatments with salicylic acid and zinc at concentrations of 150 mg L-1 and 100 mg L-1, as the highest average for the trait was reached. 41.46 leaves, While the lowest average was recorded for the control treatment, which amounted to 31.46 leaves -1, a difference of 31.78%. The reason for this may be attributed to a response to zinc and the role of this element in cell division (Mohsin et al., 2014). Also, increasing the leaf area, which is associated with an increase in vegetative growth traits, such as plant height and number of leaves, was reflected in improving the leaf area characteristic. Thus, the number of seeds in the pod is a result of the role of zinc in improving plant growth, activating photosynthetic enzymes, transporting absorbed materials, and forming chlorophyll (Movahhedy-dehnavy et al., 2009).

5- Number of branches (Branch plant^{-1}).

Table (5) The effect of spraying with salicylic acid and zinc on the number of branches (Branch plant^{-1}).

Zinc concentration mg l^{-1}	Concentration of salicylic acid, mg L^{-1}			Zinc element average
	0	100	150	
0	3.30 c	3.70 c	3.50 c	3.50 b
100	3.70 c	5.20 b	5.90 a	4.93 a
Salicylic acid average	3.50 b	4.45 a	4.70 a	

*Similar letters indicate that there is no significant difference at the 0.05 probability level.

Table (5) regarding the character of the number of branches indicates a significant difference between the spraying treatments with salicylic acid, as the highest average of the character was recorded at the concentration of 150 mg L-1 and 100 mg L-1. It reached 4.70 plant branches and 4.45 branches respectively, while the lowest average for the control treatment amounted to 3.50 plant branches. A difference of 34%.

The results indicate that with spray treatment with salicylic acid at concentrations of 100 and 150 mg L-1, a significant increase was recorded in all vegetative growth traits. The reason may be due to the role of salicylic acid in the process of rapid cell division and elongation due to the synergy between phenol and auxin. The same concentrations also caused an increase in the number of leaves and leaf area, which is directly linked to an increase in plant height. The number of branches, or perhaps the reason is due to the effect of salicylic acid enhancing chemical reactions due to its role in accelerating the divisions that occur in the apical part of the shoots (Hussien et al. (2011), in addition to increasing the rate of photosynthesis and cell division, thus producing many branches. It also provides nutrients (El-Shafey et al., 2020 Orabi et al., 2013).

The same table indicates that there are significant differences between the spraying treatments with zinc, as the highest average was recorded at the concentration of 100 mg L-1 reaching 4.93 branches, while the lowest average was recorded for the treatment in control, it reached 3.50 branches plant-1 a difference of 40.85%. As for the role of the zinc element, the results of the table indicate an increase in plant height. Table (1) as a result of spraying with the zinc element, which was reflected in Positively, the increase in the number of branches These results are consistent with the findings of (Teixeira et al., 2004 and Bozorgi et al., 2011), which were reflected in the increase in vegetative growth due to its inclusion as an important factor in the processes of photosynthesis, respiration, and biochemical and physiological processes. Combined, they increase the total yield of the plant (Rietra et al., 2017. Khan et al., 2022). The statistical analysis table indicates a significant difference between the spraying treatments with salicylic acid and zinc at the concentrations of 150 mg L-1 and 100 mg L-1, as the highest average for the characteristic was reached. 5.90, branch, while the lowest average for the trait for the control treatment was 3.30 branch plant-1, a difference of 78.78%.

CONCLUSIONS

The current study was conducted to determine the influence of salicylic acid and zinc on growth of bean plants. Leaf area increased with increasing concentrations level of salicylic. Spraying with zinc has a positive effect on growth traits of beans, plant height, number of leaves, leaf area, number of branches, and amount of chlorophyll. As for the interaction coefficients, the interaction coefficients between spraying with salicylic acid level at 150 mg L-1 and zinc spraying at 100 mg L-1 were significantly higher in all the traits studied. Considering the parameters of vegetative growth and the amount of chlorophyll from this study, it was concluded that foliar spraying with salicylic acid and zinc recorded an increase in growth traits of the bean plant while reducing stress when used intermittently, which is reflected in the vigorous plant growth.

REFERENCES

Atab, H. A., Aboohanah, M. A., & Al-Ubori, R. (2023, Novemb. Effect of Salicylic Acid Spraying on Physiological and Enzymatic Characteristics of three Broad Bean cultivars under Saline Soil Conditions. In IOP Conference Series: Earth and Environmental Science. 1259,(1), p. (012099). IOP Publishing.

Al-Hilfy, Intsar H.H, H. M. K. Al-Abodi, Hiba.M. Hardan, A. Y. Nasseralla.2017. Response of faba bean to spraying salicylic acid. American-Eurasian Journal of Sustainable Agriculture.11(3): pp 1-6.

Anchra, S., Kaushik, M., Choudhary, J., Meena, R. S., & Dhayal, S. (2024). Influence of phosphorus, sulfur, and zinc levels on yield, quality, and nutrient uptake of lentils (*Lens culinaris*) in the sub-humid southern plain of Rajasthan. Indian Journal of Agronomy, 69(2), 200-205 ..

Arif, Y., Sami, F., Siddiqui, H., Bajguz, A. and Hayat, S. (2020) Salicylic acid in relation to other phytohormones in plant: a study towards physiology and signal transduction under challenging' environment. Environmental and Experimental Botany 10: 40-45 .

Bozorgi, H. R., Faraji, A., Danesh, R. K., Keshavarz, A., Azarpour, E., & Tarighi, (2011). Effect of plant and Amino Acid on Pea Plant (*Pisum sativum*) Late Season, Growth and Production. Polish Journal of Environmental Studies, 32(3).

El-Shafey, Amina I., A. M. El-Garhy and M. M. H. Rahha.2020. Effect of Foliar Spraying Faba Bean Plants with Some Botanical Extracts and Salicylic Acid on Growth, Yield and Chocolate Spot Disease Severity. Alex. J. Agric. Sci. Vol. 65, No.6, pp. 349-369.

Hossain, M. D.; K. H. Talukder; M. Asaduzzaman; F. Mahmud; N. Amin and M. A. Sayed (2011). Study on morphological characteristics of different genotypes of Gladiolus flower. J. Sci. Foundation, 9(1&2): 01-08.

Hossain, M. D.; K. H. Talukder; M. Asaduzzaman; F. Mahmud; N. Amin and M. A. Sayed (2011). Study on morphological characteristics of different genotypes of Gladiolus flower. J. Sci. Foundation, 9(1&2): 01-08.

Khan, M. M. H., Ahmed, N., Naqvi, S. A. H., Ahmad, B., Dawar, K., Rahie, A. A., Danish, S. (2022). Synchronization of zinc and boron application methods and rates for improving the quality and yield attributes of Mangifera indica L. on a sustainable basis. Journal of King Saud University - Science, 34(8), 102280. https://doi. org/10.1016/j.jksus.2022.102280.

Movahhedy-Dehnavy, M., Modarres-Sanavy, S. A. M., & Mokhtassi-Bidgoli, A. (2009). Foliar application of zinc and manganese improves seed yield and quality of safflower (Carthamus tinctorius L.) grown under water deficit stress. Industrial Crops and Products, 30, 82-92. https://doi. org/10.1016/j.indcrop.2009.02.004.

Mohsin, A. U., Ahmad, A. U. H., Farooq, M., & Ullah, S. (2014). Influence of zinc application through seed treatment and foliar spray on growth, productivity, and grain quality of hybrid maize. Journal of Animal and Plant Science, 24(5), 1494-1503. Retrieved from http://www.thejaps. org. pk/docs/v-24- 5/29.

Orabi, S.A., B. B. Mekki and F A. Sahara. 2013. Alleviation of adverse effects of salt stress on faba bean (*Vicia faba* L.) plants by exogenous application of salicylic acid world appl. Sci. J. 27 (4):418-427.

Patil, B., & Chetan, H. T. (2018). Foliar fertilization of nutrients. Marumegh, 3(1), 4953.

Padmapriya, S. and N. Chezhiyan (2002). Influence of Gibberellic acid and certain other chemicals on flowering character of chrysanthemum (Dendranthema grandiflora Tzvelev.) cultivars. South Indian Hort., 50(4-6): 437-443.

Ray, H., Bock, C. and Georges, F. (2015). Faba bean: transcriptome analysis from etiolated seedling and developing seed coat of key cultivars for synthesis of proanthocyanidins, phytate, raffinose family oligosaccharides, vicine, and convincing. Plant Genome Us, 8 (1).

RATHORE, K., PAL, A., & SINGH, A. K. (2022). Efficacy of various doses of salicylic acid, naphthalene acetic acid and gibberellic acid on vegetative growth and pod yield of broad bean (*Vicia faba* L.) Annals of Plant and Soil Research, 24(1), 86-90.

Rehman, S. U., Ahmed, U., Zahoor, A., Rahman, Z. U., Ullah, I., Khan, S., & Ali, S. (2024). Foliar zinc and soil applied molybdenum optimize yield and dry matter partitioning of lentil.

Rietra, R. P., Heinen, M., Dimkpa, C. O., & Bindraban, P. S. (2017). Effects of nutrient antagonism and synergism on yield and fertilizer use efficiency. Communications in Soil Science and Plant.

Sadik, K. S: al-Taweel; N.S. Dhyeab and Kalaf M. Z. (2011). A new computer program for estimating leave area of several vegetable crops. American Eurasian Journal of Sustainable Agriculture., 5(2):304-309.

Seifinadergholi, M, Yarnia M, Rahimzade Khoei F 2011. Effect of zinc and manganese and their application method on yield and yield components of common bean (*Phaseolus vulgaris* L. CV. Khomeini). Middle-East Journal of Science and Research. 2011; 8(5):859-865.

Teixeira, I. R., Boren, A. B., & Araujo, G. A. A. (2004). Manganese and zinc leaf application on common bean grown on a cerrado soil. Scientia Agricola, 61, 77-81. https.

Yousefi, Z., Sharifi, P., & Rabiee, M. (2023). Effect of foliar application of zinc and iron on seed yield and yield components of common bean (Phaseolus gibberellic acid on vegetative growth and pod yield of broad bean (*Vicia faba* L.) Vegetative growth and pod yield of broad bean (*Vicia Faba* L.). Annals of Plant and Soil Research, 24(1), 86-90 .vulgaris. AGRIVITA Journal of Agricultural Science, 45(1) 154-162.

Zafar, S, Ashraf A, Ijaz MU, Muzammil S, Siddique MH, Afzal S,Andleeb, R, Al-Ghanim KA, Al-Misned F, Ahmed Z (2020). Ecofriendly synthesis of antibacterial zinc nanoparticles using Sesamum indicum L. extract. J King Saud Univ Sci 32:1116–1122.Ahmad, B., Hussain, F., Shuaib, M., Shahbaz, M., Hadayat, N., Shah, M. & Alharbi, K. (2023). Effect of Salicylic Acid and Amino Acid on Pea Plant (*Pisum sativum*) Late Season, Growth and Production. Polish Journal of Environmental Studies, 32(3).