FOLIAR APPLICATION INFLUENCE OF BORON, SEAWEED AND YEAST EXTRACTS ON THE GROWTH AND YIELD OF STRAWBERRY *(Fragaria × ananassa)* PLANTS

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ABSTRACT

This study takes place during the season of growing 2021 in Grdarasha filed, collage of Agricultural Engineering Science, Salahaddin University, Kurdistan Region / Iraq. It consist of three different experiments to investigate the influence of foliar application of boron, seaweed extract and yeast with three concentrations of boron (0, B1=10 and B2=20 $mg.L^{-1}$), three concentrations of seaweed (0, S1=2 and S2=4 $ml.L^{-1}$) and three concentrations of yeast (0, Y1=3 and Y2=6 $g.L^{-1}$), on some vegetative and fruit growth characteristics of strawberry (*Fragaria × ananassa Duch*) plants Robygum cv., spraying was done every 15 days and repeated 3 times beginning at 1 April. A factorial experiment with three replicates was carried out in a Completely Randomized Design (CRD) using three plants for each experimental unit. The obtained results indicated that the vegetative (leaf area, chlorophyll content, shoot fresh weight and shoot dry weight) and fruit (fruit set, fruit diameter, fruit fresh weight, fruit dry weight and T.S.S) characteristics were increased significantly by increasing the concentration of the fertilizers as compared with control for each experiments, at level (20 $mg.L^{-1}$) of boron, (4 $ml.L^{-1}$) of seaweed extract and yeast at (6 $g.L^{-1}$), while acidity for the three experiments was decreased at the level(6 $g.L^{-1}$) and the highest value of acidity was recorded at control treatments.

Key Words: Boron, Seaweed, Yeast, strawberry plants and Robygum cv.

INTRODUCTION:

Strawberry (*Fragaria ananassa* Dutch) is a highly appreciated worldwide not only for its unique taste and distinct flavor, but also for its health benefits. Strawberries contain usual nutrients, such as minerals and vitamins, and a diverse range of anthocyanin, flavonoids and phenolic acids with biological properties, such as antioxidant, anticancer, anti-neurodegenerative and anti-inflammatory activities (Seeram *et al*., 2006). Strawberry is a small fruit crop with high nutritional and medicinal value that is a member of the Rosaceae family (Zhao, 2007). It is one of the most popular fruits in the world, ranking fourth after apples, oranges, and bananas (Virginie, 2010). It is also one of the fruits with the highest concentrations of natural antioxidants, as well as an excellent source of ascorbic acid, potassium, fiber, and simple sugar. In addition to the standard nutrients like vitamins and minerals (Perez *et al.*, 1997). Crop yield and early harvests are most important to growers, but fruit quality is most important to consumers.

Many researchers emphasized the importance of the fertilization process for the plant because of its role in increasing production, which at the same time leads to increased environmental pollution caused by the use of chemical fertilizers that are harmful to human health and raises production costs, so the search for new sources may be an

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alternative. To reduce the damage caused by chemical fertilizers, block the plants' need for nutrients. Organic and biofertilizers are more useful and effective than chemical fertilizers (De-Ell and Prange, 1993), and they are safer in the manufacturing process for either applicators or consumers (Mba, 1994).

As for Boron, has been shown to play a role in a variety of biological and physiological processes within plants, including carbohydrate transfer, differentiation, cytotoxicity, nitrogen metabolism, nucleic acid formation, plant hormone regulation, lipid metabolism, phosphorus, photosynthesis, active and inducing the formation of phenolic compounds, and their role in fertilization (Taiz and Zeiger, 2010).

According to Eman *et al.,* (2008), the addition of dry yeast with some fertilizers produced positive results. El-Miniawy *et al.,* (2014) discovered that spraying seaweed extract had a positive effect on sweet Charlie strawberry plant growth, fruit yield, and quality. AL- Karawi *et al.,* (2018) demonstrated that spraying the plants with dry yeast and boron on strawberry growth and production resulted in a significant increase in plant height, number of leaves, and total sugar content of the fruits. AL-Shatri *et al.,* (2019) showed that increasing seaweed extract applications had significant effects on the number of flowers per plant, yielding and significant increase in fruit quality (TSS/TA ratio) compared to the control treatment and increasing seaweed application caused a significant decrease in the TA of the fruit.

Plant extracts are starting to be used in agricultural production, such as seaweed extract, which is a significant organic source. Because it is abundant in macro and micro elements and plant hormones like auxins, gibberellins, and cytokinin that induce cell division and increase cell enlargement and lead to a balance of physiological and biological processes as well as an increase in photosynthesis processes and improved growth characteristics, it works to stimulate the physiological functions in the plant (Jensen, 2004). Moreover, when sprayed on plants or added to the soil, they have significant physiological effects because they make plants more resilient to harmful environmental factors, disease, and insect infestation (Spinelli *et al.,* 2009).

Dry yeast (*Saccharomyces cerevisiae*) is one of the types of bio-fertilizers used in soil fertilization and foliar nutrition for various crops, according to EL-Ghamring *et al.,* (1999), because it contains a variety of amino acids, proteins, and other nutrients that are crucial for plant growth. They also produce plant-like growth regulators like auxins, gibberellins, and cytokines (Tawfiq and Arwa, 2010). Urech (1978) noticed that dry yeast has the capacity to store surplus phosphorus in chains made up of 20 to 200 units of phosphate in the spaces inside the cell. It was recorded in the field.

The aim of this study is to show the influence of different concentration via foliar application of boron, seaweed extract and yeast on the growth and yield of strawberry cv. Rubygem that cultivation in Kurdistan reign.

METHODS AND MATERIALS

This study was conducted carried out in the fields of Gradarasha, Horticulture department-collage of Agricultural Engineering Science ,during 2021. It consists of three different experiments without interactions. The experimental design in this study is a completely randomized design (CRD) with three replications for each experiment, Tween-20, as a wetting agent at 0.1% was added to all foliar solutions of treatments, that applied on strawberry plants Rubygem cultivar, spraying was done every 15 days and repeated 3 times beginning at 1 April. Some growth parameters were studied and measured. The treatment was compared according to Duncan's multiple comparison tests at 5% level according to (Al-Rawi and khalafalla, 2000). Some parameters of plant were studied, shoot fresh weight,

shoot dry weight, leaf area, chlorophyll content, fruit set percentage, fresh weight of fruit, dry weight of fruit, fruit diameter, T.S.S, and acidity. The fruit diameter measured by vernier, leaf area (cm^2/plant), chlorophyll meter SPAD 502 was used to measure leaves'total chlorophyll content. T.S.S measured by used the Refractometer, plants were treated with three different levels namely:

-First experiment:

1. Control, Only sterilized water
2. Boron 10 $mg.L^{-1}$ (B1)
3. Boron 20 $mg.L^{-1}$ (B2)

-Second experiment:

1. Control, Only sterilized water
2. Seaweed extract 2 $ml.L^{-1}$ (S1)
3. Seaweed extract 4 $ml.L^{-1}$ (S2)

-Third experiment:

1. Control, Only sterilized water
2. Yeast 3 $g.L^{-1}$ (Y1)
3. Yeast 6 $g.L^{-1}$ (Y2)

RESULT AND DISCUSSION

Table 1 showed a significant increase for all the studied parameters at the level (20 $mg.L^{-1}$) of boron, leaf area, chlorophyll, shoot fresh weight and shoot dry weight, (98.87 cm^2), (39.77%), (68.10 g) and (21.66 g) respectively.

Table (1): Influence with boron foliar on some vegetative growth of strawberry plants

Treatments	Leaf area Cm^2	Chlorophyll content %	Shoot fresh weight g	Shoot dry weight g
Control	**61.48 c**	**35.98 c**	**55.49 c**	**17.56 c**
B 1	**85.27 b**	**38.04 b**	**63.73 b**	**19.91 b**
B 2	**98.87 a**	**39.77 a**	**68.10 a**	**21.66 a**

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

Data from table 2 recorded the highest value at level (4 $ml.L^{-1}$) of seaweed extract and increased significantly for the studied parameters, leaf area, chlorophyll, shoot fresh weight and shoot dry weight, (97.66cm^2), (40.45%), (67.90g) and (21.31g) respectively.

Table (2): Influence with seaweed extract foliar on some vegetative growth of strawberry plants

Treatments	Leaf area Cm^2	Chlorophyll content %	Shoot fresh weight g	Shoot dry weight g
Control	**60.34 c**	**36.20 c**	**56.03 c**	**17.79 c**
S 1	**88.29 b**	**38.33 b**	**64.21 b**	**20.05 b**
S 2	**97.66 a**	**40.45 a**	**67.90 a**	**21.31 a**

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

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It is clear from table 3 that the parameters significantly increased at level (6 g. L^{-1}) of yeast, leaf area, chlorophyll, shoot fresh weight and shoot dry weight, (97.66cm^2), (40.45%), (67.90g) and (21.31g) respectively.

Table (3): Influence of yeast on some vegetative growth of strawberry plants

Treatments	Leaf area Cm^2	Chlorophyll content %	Shoot fresh weight g	Shoot dry weight g
Control	**63.06 c**	**37.32 c**	**56.28 c**	**17.58 c**
Y 1	**89.53 b**	**39.11 b**	**65.97 b**	**20.41 b**
Y2	**100.39 a**	**41.45 a**	**69.46 a**	**21.92 a**

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

Table 4 recorded the highest value of the studied parameters at level (20 mg.L^{-1}), fruit set%, fruit diameters, fruit fresh weight, fruit dry weight and T.S.S, (79.83%), (2.91 cm), (16.21 g), (7.32 g) and (11.57) respectively. The highest value of acidity percentage was recorded at control treatment (87.34%).

Table (4): Influence with boron foliar on some fruit parameters of strawberry plants

Treatments	Fruit set %	Fruit diameter cm	Fruit fresh weight g	Fruit dry weight g	T.S.S	Acidity%
Control	**70.22 c**	**1.87 c**	**10.09 c**	**4.11 c**	**5.98 c**	**87.34 a**
B1	**75.91 b**	**2.49 b**	**14.35 b**	**6.41 b**	**8.66 b**	**80.20 b**
B2	**79.83 a**	**2.91 a**	**16.21 a**	**7.32 a**	**11.57 a**	**77.33 c**

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

Table 5 showed that the studied parameters were significantly increased at level (4 ml.L^{-1}), fruit set%, fruit diameters, fruit fresh weight, fruit dry weight and T.S.S, (80.41%), (2.94 cm), (15.27 g), (6.94 g) and (10.28) respectively. The highest value of acidity percentage was recorded at control treatment (88.11%).

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Table (5): Influence with seaweed extract foliar on some fruit parameters of strawberry plants

Treatments	Fruit set %	Fruit diameter cm	Fruit fresh weight g	Fruit dry weight g	T.S.S	Acidity%
Control	70.38 c	1.45 c	10.34 c	4.23 c	6.10 c	88.11 a
S1	76.29 b	2.48 b	14.54 b	6.27 b	8.90 b	80.06 b
S2	80.41 a	2.94 a	15.27 a	6.94 a	10.28 a	76.98 c

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

Concerning the effect of active dry yeast concentrations, it was clearly observed in table 6 that all studied parameters were significantly increased at level (6 g. L^{-1}), fruit set%, fruit diameters, fruit fresh weight, fruit dry weight and T.S.S (80.92%), (3.01 cm), (16.33 g), (7.12 g) and (12.87) respectively. The highest value of acidity percentage was recorded at control treatment (87.94%).

Table (6): Influence of yeast on some fruit parameters of strawberry plants

Treatments	Fruit set %	Fruit diameter cm	Fruit fresh weight g	Fruit dry weight g	T.S.S	Acidity%
Control	70.50 c	1.60 c	10.02 c	6.19 c	6.12 c	87.94 a
Y1	77.27 b	2.83 b	14.19 b	6.08 b	9.44 b	80.02 b
Y2	80.92 a	3.01 a	16.33 a	7.12 a	12.87 a	76.01 c

* The values that carry the same alphabet are not significantly from each other according to the Duncan multiplicity test at a probability level of 0.05.

It is clear from the above results that there are differences in the response of vegetative growth and plant yield to the levels of boron, seaweed extract and dry yeast, and these differences represent positive effects in the studied traits. It was observed that the spraying treatments with boron were significantly excelled on the control treatment in increasing the vegetative growth and yield, due to boron plays a key role in a diverse range of plant functions including cell wall formation and stability, maintenance of structural and functional integrity of biological membranes, movement of sugar or energy into growing parts of plants, and pollination and seed set (Waqar *et al.*, 2009).

Fertilizing with seaweed extracts provides plants with potassium, zinc, iron, magnesium, and nitrogen. Seaweed plant foods only provide trace amounts of the macro-nutrients and enhanced the net photosynthetic rate, transpiration rate, and water use efficiency, and increased N, P, or K utilization efficiency,

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(Diwen Chen *et al.*, 2021). yeast have been shown to positively affect that led to an increase in the fruit content of the total sugars and the plant yield. The effect of the addition of yeast on the total vegetative may be due to the fact that leaves are an important center in which many physiological and biological processes occur, as well as an effective method of absorbing and transferring nutrients better within the plant. On the other hand, the importance of bread yeast to improve the traits of vegetative growth due to what contain of nutrients such as nitrogen to the increase and activate the vital activities of plants by stimulating the enzymatic systems, and to stimulate it in the production of plant hormones which encouraged the process of cellular division and elongation of cells, (Al-Karawi *et al.*, 2018).

REFERENCES:

1. Al-Rawi, S. and Khalafalla, M.A. (2000). Design and analysis of agricultural experiments. National Library for printing and publishing- University of Mosul. 2nd edn: 2000.
2. AL- Karawi H. N., Salman F. A. and Al-Mosawi J. J. (2018). Effect of spraying with dry yeast (*Saccharomyces cerevisiae*) and boron on the growth and production of the strawberries plant cultivated under the conditions of protected agriculture. *Euphrates Journal of Agriculture Science.* 1(3): 60 – 68.
3. AL-Shatri, A. H. N. Pakyürek, M. Yaviç, A. 2019. Effect of seaweed application on the vegetative growth of strawberry cv. Albion grown under Iraq ecological conditions. *Applied Ecology and Environmental Research.* 18(1):1211-1225.
4. Caroline C. Mba. (1994). Field Studies on two rock Phosphate Solubilizing Actionmycete Isolates as Bio-fertilizer Sources. Environ. Management, 18(2): 236-36.
5. De-Ell, J. R. and Prange, R. K. (1993). Post-harvest physiological disorders diseases and mineral concentrations of organically and conventionally grown "McIntoch" and "Cortland" apples. *Canadian Journal of Plant Sciences*. 18 (8B). p.559-574.
6. Diwen Chen, Wenling Zhou, Jin Yang, Junhua Ao, Ying Huang, Dachun Shen, Yong Jiang3, Zhenrui Huang and Hong Shen. (2021). Effects of Seaweed Extracts on the Growth, Physiological Activity, Cane Yield and Sucrose Content of Sugarcane in China.
7. EL-Ghamring, E. A, Arish, H. M. and Nour, K. A. (1999). Studies on Tomato Flowering, Fruit Set, Yield, and Quality in the Summer Season. I. Spraying with Thiamine, Ascorbic Acid, and Yeast. Zagazig. *J. Agric. Res*. 26(5):1345-1364.
8. El-Miniawy, S. M., Ragab, M. E., Youssef, S. M. and Metwally, A. A. (2014). Influence of Foliar Spraying of Seaweed Extract on Growth, Yield and Quality of Strawberry Plants. *Journal of Applied Sciences Research*. 10(2): 88-94.
9. EL-Tohamy, W. A., EL-Abagy, H. M. and EL-Greadly, N. H. (2008). Studies on the Effect of Yeast Putyescine and Vit.C on Growth, Yield and Physiological Responses of Eggplant Under Sandy Soil Condition. Aust. *J. Agric. and Biol. Sci.* 2(2):296-300.
10. Eman, A. A., M. M. S. Saleh and E. A. M. Mostafa (2008). Minimizing the quantity of mineral nitrogen fertilizers on grapevine by using humic acid, organic and bio fertilizers. *Research Journal of Agriculture and Biological Sciences*. 4(1):46-50.
11. Jensen, E. (2004). Seaweed; fact or fancy. Published by Moses the Midwest Organic and Sustainable Education. *From the broad Caster*. 12(3): 164- 170.
12. Perez, A.G., R. Olias, J. Espeda, J.M. Olias and C. Sanz, (1997). Rapid determination of sugars, nonvolatile acids, and ascorbic acid in strawberry and fruits. *J. Agr. Food Chem*., 45: 3545–3549.
13. Seeram, N.P., L.S. Adams, Y. Zhang, R. Lee, D. Sand, H.S. Scheuller, and D. Heber (2006). Blackberry, black raspberry, blueberry, cranberry, red raspberry, and strawberry extracts inhibit growth and stimulate apoptosis of human cancer cells in vitro. *J. Agric. Food Chem*., (54): 9329-9339.
14. Taiz, L. and D. Zeiger (2010). Plant Physiology. Fourth Edition. Sinauer Assciates Inc., Publishers Sunderland, MA., USA.

15. Tawfiq, Arwa A. (2010). Estimation levels of Indol Acetic Acid (IAA) and Gibberellic Acid (GA3) From Dry Bakery Yeast *Saccharomyces cereviciae*. *Journal of Biotechnology Research center*. 4(2): 94-100.
16. Urech, K., M. Duitt, T. Boller and A. Wiemken (1978). Localization of Polyphosphate in Vacuoles *Saccharomyces cerevisia*. *Arch. Microbiol*. 16: 275-278.
17. Virginie, P. (2010). Pariability of Health and Taste Promoting Compounds in Strawberry (*Fragaria* x *ananassa*) Fruit. A dissertation Doctor of Sciences. ETH Zurich. Swiss.
18. Waqar Ahmad, A. Niaz, S. Kanwal, Rahmatullah and M. Khalid Rasheed. (2009). Role of boron in plant growth: a review. *J. Agric. Res.*, (3): 329-338.
19. Zhao, Y. (2007). Berry Fruit. Print in the United States of America on acid – free paper.

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