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Physiological study on the effects of seaweeds extract and hydrogen peroxide stress on growth of bean plant vicia faba L.

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Abstract: An experiment was conducted using pots in the Botanical Garden of Biology Department, College of Education of Pure Sciences (Ibn Al-Haitham), University of Baghdad the 2020-2021 growth season to find out the effect of hydrogen peroxide and seaweeds extract in some growth characteristics of Vicia faba L. The concentrations used 5%, 10% hydrogen peroxide and 50,75,100 mg^{-1} of seaweeds extract, and the results showed that hydrogen peroxide with a concentration of 10% led to asignificant decrease in plant height, SPAD content, dry weight gm, Mn, Zn and Fe content $mg.L^{-1}$, as well as the results showed that extract led to a significant increase in all the characteristics studied.

Keywords: Hydrogen peroxide, Seaweeds, Viciafaba L.

1. INTRODUCTION

The beans plant is one of the important crops that belongs to Fabaceae family. It is a major food source in many countries of the world and it is an annuals plant and native to East Asia, North Africa and the Mediterranean basin and there are types of bean plant growing in the Oras Mountains, planted and eaten green by the Greeks and known by China since 1928, as well as countries in Europe, including Italy, France and Asia, and used by the Easterners more than the Westerners in their food, especially third world countries, in order to make up for the shortage of their food meat because of the plant's vegetable protein (Mcvicar*et al.* 2013).

The beans plant is an important food source for humans as it is rich in nutrients important to humans, as dry seeds contain many substances, including protein, starchy and fatty substances, as well as some elements such as potassium, phosphorus and ferric, additionally containing other substances such as water, fiber and secondary metabolic compounds such as tannins and lectine (Fouad*etal*., 1995).

The beans plant is used as animal feed and in increasing soil fertility to contain the roots of beans on the root nodes fixated for nitrogen, which takes nitrogen from the air and fixated it in the soil, which increases its fertility and vitality and as such is important characteristic for other plant cultivated. The beans plant is the best source of nitrogen for these plants, especially the plants of Germania family (Fageria,2005;Ruiz-Ramos and Minguez,2006).

Hydrogen peroxide is a type of stress also called oxygen water, a compound with H_2O_2 formula, which is considered a weak acid and has many key roles in the process of

metabolism for the plant, participates in a wide variety of interactions and sequences the signals necessary for all aspects the growth of root hairs and the differentiation of xylem andlignification, and the organization of the process of closing and opening stomata and also participating in the processes of metabolism and natural growth of the plant (Checseman, 2007). It is the result of two electronic reduction of oxygen (Halliwell*etal*,2000) and is stable and inactive with high concentrations, and this property gives it the ability to move within the tissues of the plant, which is the main material in a variety of interactions, as it is considered as a moleculerof signs related to reactive oxygen species (ROS) is found within the tissues and sometimes in the walls of the root hair cells (Carol and Dolan,2006) or in epidermis cells indicates the extent to which it controls the internal environment of the plant (Allan and Fluhur, 1997).

Algae are simple-structured thallophyticplants with roots and leaves that are not flowers, fruits or seeds and they are the basis for the development of various plants and they are a major source of oxygen production asit performs photosynthesis because it contains chlorophyll a as well as other assistant pigments such as carotenoids, xanthophylls(Al-Saadi and Suleiman, 2006).Algae are divided into eight divisions found in various plants, some of which are used as organic or biological fertilizers, including green algae Chlorophyta, red algae Rhodophytaand brown algae Phaeophyta, and because of the increased interest in the environment and the emphasis on clean agriculture, this has led to the use of seaweedextracts in agricultural production as they are considered non-toxic substances by their biological nature, environmentally friendly and do not leave any residues on soil and plant as well as they are organic fertilizer-supplementing sources, because they work to improve and increase the effectiveness of fertilizers and they work to improve and increase the effectiveness of fertilizer and then reduce production costs (Kahan*etal.*,2009; Zamani*etal.*,2013).Therefore, the aim of the study is to identify the effect of hydrogen peroxide and seaweed extract in some characteristics of vegetative growth and physiological characteristics.

2. MATERIALS AND METHODS

An experiment was conducted using pots capacity of 5 kg and a diameter of 30 cm in the botanical garden of Biology Department, College of Education for Pure Sciences (Ibn Al-Haitham) for the growth season 2020-2021 and the seeds of beans were obtained from the local markets, the experiment was designed with Complete Random Design (CRD) and three repeaters per treatment, planted 10 seeds in each pots, prepared hydrogen peroxide concentrations 5% and 10%, and the concentrations of seaweed extract 50 and 100 $mg.L^{-1}$. The seeds of the beanswere planted on 12 November 2020, the plants were sprayed with hydrogen peroxide in the early morning when the plant reached stage 4-6 leaves, then sprayed the plants with seaweed extract 48 hours later and harvested the plants on 7 March 2021 and the following characteristics were measured:

1. Plant height (cm): Plant height was measured from its soil contact area to the end of the developing apex of three plants of eachtreatment (Wiersma*etal*.,1980).
2. Chlorophyll estimate (SPAD): Chlorophyllwas estimated in the leaves for three plants taken randomly and for three repeatersusing chlorophyll-502 spad a manual digital meter.
3. Dry weight (gm): The dry weight of the totalvegetative of three plants randomly taken from each treatment was calculated by three repeaters, the plants were placed in paper bags and dried in oven at a temperature of 65-75°C, and the weight was calculated using a sensitive balance.

4. Estimate the content of Fe, Mn, Zn in the plant:They were estimated using atomic absorption Spectrophotometer by Allan (1961)method.

3. RESULT AND DISCUSSION

The results of table (1) showed that the rise of the plant has decreased significantly by increasing the concentration of hydrogen peroxide, giving the concentration 10% the lowest average of 31.08 and a decrease of 5.82%, as the table showed that the effect of seaweed extract significantlyin the characteristic of plant height (cm) gave the concentration 100 mg.L^{-1} the highest average at 33.89% and an increase of 24.01%.The interaction was significant and the highest value of interaction at concentration was 10% peroxide and 100 mg.L^{-1} of seaweed extract amounted to 35.00 cm, while the lowest value of interaction was 10% H_2O_2 and 0 from seaweed extract amounted to 21.32 cm.

Table (1): Effect of hydrogen peroxide and seaweed extract and their interaction in plant height (cm)

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	33.33	34.33	32.00	32.33	33.00
5	27.33	31.33	34.00	34.33	31.75
10	21.32	34.00	34.00	35.00	31.08
Mean	27.33	33.22	33.33	33.89	
LSD 0.05	H_2O_2	Seaweed extract	H_2O_2× Seaweed extract		
	0.868	1.002	1.736		

The results of table (2) indicated that the content of chlorophyll (Spad) decreased significantly when the concentration of hydrogen peroxide increased, the concentration 10% giving 51.72 and a decrease rate of 3.75%. The same table indicated that the effect of seaweed extract in the content of chlorophyll Spad was significant, giving the concentration 100 mg.L^{-1} the highest average of 52.08Spad and an increase rate of 7.14%. The interaction was significant, giving the concentration zero hydrogen peroxide and 0 from seaweed extract the highest value of 54.03, while the lowest value of interaction was 45.50% when concentrated 10% hydrogen peroxide and zero from seaweed extract.

Table (2):Effect of Hydrogen peroxide and seaweed extract and their interactionon chlorophyll content (Spad).

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	54.03	51.27	49.73	51.83	51.72
5	46.30	51.50	51.47	50.46	49.93
10	45.50	48.56	51.07	53.97	49.78
Mean	48.61	50.44	50.76	51.84	
LSD 0.05	H_2O_2	Seaweed extract	H_2O_2×Seaweed extract		
	0.757	0.874	1.514		

Table 3 results showed a significant decrease in dry weight (gm) by increasing the concentration of hydrogen peroxide, giving the concentration 10% the lowest average of 5.47gm and a decrease of 17.99%. As for the effect of seaweed extract, the same table indicated a significant effect in the dry weight (gm) characteristic, giving the concentration 100 mg.L^{-1} on average of 5.89 gm and an increase of 6.32%.The effect of interaction was significant, the highest concentration value was zero hydrogen peroxide zero of seaweed extract of 6.61 gm, while the lowest value of interaction was 10% hydrogen peroxide and 00 of seaweed extract amounted to 4.51 gm.

Table (3). Effect of hydrogen peroxide and seaweed extract and their interaction in dry weight (gm).

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	6.61	5.56	6.24	6.28	6.17
5	5.51	5.60	5.94	5.64	6.67
10	4.51	6.16	5.50	5.71	5.47
Mean	5.54	5.77	5.89	5.88	
LSD 0.05	H_2O_2	Seaweed extract		H_2O_2× Seaweed extract	
	0.512	0.591		1.023	

Table 4 results showed that there was a significant effect on Mn content in the total vegetative mg.L^{-1}, where hydrogen peroxide caused a significant decrease in Mn content, giving the concentration 10% of hydrogen peroxide an average of 26.13 mg.$L^{-1}$and a decrease of 19.38%, as the same table showed a significant increase in Mn content by increasing the concentration of seaweed extract, giving the concentration 100 mg.L^{-1} the highest average of 29.43 mg.L^{-1} and an increase of 13.06%.The interaction was significant, giving the concentration zero hydrogen peroxide and 75 mg.L^{-1} of seaweed extract at the highest interaction level of 33.10 mg.L^{-1}, and the lowest interference value was 25.00 mg,L^{-1} at concentration, 5%, 10% hydrogen peroxide, 50 and 75 mg.L^{-1} of seaweed extract.

Table (4). Effect of hydrogen peroxide and seaweed extract and their interaction in the content of Mn mg.L^{-1}.

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	31.80	32.90	33.10	31.80	32.40
5	26.60	25.00	28.00	27.00	26.65
10	22.70	27.30	25.00	29.50	26.13
Mean	26.77	28.47	28.70	29.43	
LSD 0.05	H_2O_2	Seaweed extract		H_2O_2×Seaweed extract	
	0.844	0.975		0.814	

The results of table (5) showed a significant decrease in Zn content in the total vegetative mg.L^{-1}, giving the concentration 10 mg.L^{-1} the lowest average of 28.28 mg.L^{-1} and a decrease of 11.21%, as the table indicated a significant increase in this characteristic by increasing the concentration of seaweed extract, the concentration gave 100 mg.L^{-1} the highest rate of 32.50 mg.L^{-1} and an increase of 25%. The interaction was significant, giving

the concentration 10% hydrogen peroxide and 100 mg.L^{-1} of seaweed extract at a higher value of 33.90 mg.L^{-1}, but the lowest interaction value was 10% hydrogen peroxide and zero of seaweed extract was 22.60 mg.L^{-1}.

Table (5). Effect of hydrogen peroxide and seaweed extract and their interaction in the content of Zn mg.L^{-1}.

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	28.60	32.20	33.40	33.20	31.85
5	26.80	26.40	31.60	30.40	28.80
10	22.60	26.80	29.80	33.90	28.28
Mean	26.00	28.80	31.60	32.50	
LSD 0.05	H_2O_2	Seaweed extract	H_2O_2×Seaweed extract		
	0.866	1.000	1.731		

Table 6 indicated a significant decline in this characteristic, giving the concentration 10% of hydrogen peroxide the lowest average of 150.08 mg.L^{-1} and a decrease rate of 37.79%, and the table indicated a significant increase in Fe content mg.L^{-1} gave the concentration 100 mg.L^{-1} of seaweed extract, the highest average of 201.67 mg.L^{-1}, an increase rate of 20.99%, while the interaction was significant and gave the concentration zero hydrogen peroxide and 100 mg.L^{-1} the highest interaction value of 300.00 mg.L^{-1}.The lowest value of interaction was 135.00 mg.L^{-1} at concentration of 10% hydrogen peroxide and concentrations zero and 75 mg.L^{-1}of seaweed extract.

Table (6). Effect of hydrogen peroxide and seaweed extract and their interaction in the content of Fe mg.L^{-1}content.

H_2O_2concentration	Seaweed extract concentrations mg.L^{-1}.				Mean
	0	50	75	100	
0	225.00	190.00	250.00	300.00	241.25
5	140.00	155.00	170.00	150.00	153.75
10	135.00	175.33	135.00	155.00	150.08
Mean	166.67	173.44	185.00	201.67	
LSD 0.05	H_2O_2	Seaweed extract	H_2O_2×Seaweed extract		
	1.334	1.540	2.668		

The decrease in plant height (cm), chlorophyll content (spad), dry weight (gm) and Mn, Fe, Zn content when treated with hydrogen peroxide may be due to the fact that hydrogen peroxide caused oxidative damage to cell components, accelerating the ageing of leaves and oxidation of cellular membranes (Upadhyay*etal*., 2007).The addition of hydrogen peroxide is also believed to lead to a decrease in the effectiveness of photosynthesis and those who have been affected by the concentration of leaves of chlorophyll (Mani *et al*., 2012), and oxidative damage from free radicals causes damage to the structure of the cell, inhibiting plant growth and development or even reaching death (Hossan*etal*., 2015) or perhaps the increase in the characteristics studied when treated with seaweed extract is due to the role of algae extracts and their semi-hormones (Tatalay and Fahey, 2001). As well as because of their macro and micro nutrients and plant hormones, particularly cytokines that have an

effective role in increasing cell division (Kuwada*et al*., 2006) Or maybe it's because algae extracts provide a portion of nitrogen needs that contribute to the construction of protein within it as a result of containing free amino acids and improve the efficiency of photosynthesis within the leaf (Abdul-Al-Muttalib, 2011).

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