ARTICLE / INVESTIGACIÓN

Response of buckthorn seedlings to foliar spraying with Kelamyth Fe and algae mixture on vegetative growth traits for cultivar AL-Tafahi

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Abstract: This study was done in the lath house of the Horticulture and Gardening Dept. / College of Agriculture / University of Anbar during the growth season 2021 to study the effect of leaf spraying kelamyth chelated Fe in three levels (0, 50, 100 mg.L^{-1}), with three levels Alga Mix of (0, 1, 1.5 g.L^{-1}) and their interaction on vegetative growth traits and leaf content of minerals for buckthorn seedlings AL-Tafahi cultivar. The results showed that the interaction between chelated kelamitic Fe and F2S2 algae mixture at a concentration (100 mg.L^{-1} kelamitic Fe + 1.5 g.L^{-1} algae mixture) had given a significant increase in plant height, number of branches, leaf area, chlorophyll, carbohydrates, Fe and saponins. Successively with values (75. 057cm, 19.183 units.seedling-1, 23.833cm2, 41.537 mg. g-1 fresh weight, 3.800%, 194.000 ppm, 1.545 c.ml-1), compared to control treatments.

Key words: Ziziphus mauritiana, chelated iron, seaweed extract, foliar spraying, Buckthorn.

Introduction

Buckthorn, *Ziziphus mauritiana* Lam belongs to the genus *Ziziphus* and grapes family Rhamnaceae includes 58 geniuses and more than 900 species and contains trees, standing or climbing bushes and rarely grasses. The original home of buckthorn trees in South Europe regions, the Himalayan mountains, North China, Sudan, the Arab Peninsula, Iraq, South America and maybe North Africa[8]. In Iraq, it's cultured in central and southern areas[1]. Buckthorn fruits are featured with delicious taste and attractive colors. They're widely consumed for their high nutrient content as they contain saccharides, proteins, organic acids, amino acids, vitamins like vitamin C and carotene, suitable concentrations of calcium, phosphorus, Fe iron, lipids, fibers mineral salts and antioxidants[4,7,16,17]. Fertilizing is a necessary process that influences the growth of fruit trees in general, and to increase fertilizing efficiency, the plant is supported via leaf fertilizing (foliar application), especially Fe iron element that is considered a microelement that is important in plant growth and development as it plays a fundamental role in nucleic acid and plastid assimilation; so, it participates manufacturing chlorophyll though it isn't included in its structure. It also acts in building cytochromes important for photosynthesis and respiration processes. It also enters plant protein manufacture[21]. Alga mixes are organic sources used for agricultural production and are fertilizer complements, not substitute[24]. They're used, therefore, in massive amounts and could reach 15 million tons in the agricultural field worldwide. These extracts induce plant growth, enhancing plant physical and chemical characteristics by containing macro and microelements, amino acids, organic acids and growth regulators like oxins and cytokinins, hormones, vitamins and polysaccharides. It functions by increasing plant resistance to salinity and draught[15]. Due to the lack of studies interested in the effect of foliar spraying of essential nutrients to buckthorn seedlings, in this study, spraying of Kelamyth Fe element and algal mixture on the shoot system of buckthorn seedlings cultivar AL-Tafahi was carried out to determine the effect of Kelamyth Fe and algal mixture on the growth of buckthorn seedlings cultivar AL-Tafahi.

Materials and methods

This study was carried out on buckthorn seedlings AL-Tatahi cultivar, inoculated on the seedy origin of two years old, cultured in black plastic anvils of 10kg capacity (soil + bitmus) in (1:1) ratio. They were treated by spraying the shoot system with Kelamyth Fe in three levels (0, 50, 100 mg.L^{-1}) and alga mix in three levels (0, 1, 1.5 mg.L^{-1}) and the trees were sprayed to wet on the following dates: April 11, 2021, May 11, 2021, June 11, 2021, September 11, 2021, and October 11, 2021. A factorial experiment (3X3) was done according to Randomized Complete Block Design (RCBD); so, the investigation included nine treatments in three replications, and every four seedlings were isolated as a single experiment unit, and the data were analyzed according to the statistical apparatus (Genstat). Mean values have been compared using the least significant difference (LSD), and subsequent studies and measurements were made.

Average Increase in Plant Height (cm)

Seedlings' height was measured using metric measuring tape starting from the stem-soil surface joint spot to the top apical meristem on the main seedling stem at the beginning and end of the experiment; the difference between the two readings is the increased value.

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Average Increase in Vegetative Branch Number (branch.seedling^{-1})

The number of components per seedling was counted according to the average number of vegetative features for each replication, then the average number of vegetative branches was extracted for each treatment.

Leaf Area (cm^2)

Measuring was done using a specified computer software where leaves were photo-scanned via a scanner with a measuring ruler to determine the space and measure the leaf area[2].

Leaf Chlorophyll Content (mg. g^{-1} fresh weight)

Total chlorophyll was estimated depending on the model of (19).

Estimating Leaf Total (Structural) Carbohydrate Content (%)

Leaf total carbohydrate content was estimated based on what's mentioned by (10).

Leaf Fe Content (ppm): leaf Fe content was estimated by the model of (11).

Estimating Leaf saponins Content (g.ml^{-1})

A 20g sample was taken, 80ml ethanol was added to the precipitant, and then re-extraction was made from 20 ml di-ether. This operation is repeated many times, and then 60ml butanol is added and filtered, and the precipitant is washed with (5% NaCl). Then, evaporate the extract and weigh the precipitant that represents saponins in sample[23].

Results

Plant height (cm)

The results in Table 1 showed the effect of foliar spraying of buckthorn seedlings, cultivar AL-Tafahi, with kelamyth Fe and seaweed mixture extract, separately or shared on the average increase in plant height. Thus, treatment F_2 at 100 mg. L^{-1} has significantly dominated, giving the highest value of 72.52cm. Followed by treatment F_1 at a concentration of 50 mg.L^{-1}, which, in turn, has dramatically dominated over F_0 and reached 69.82cm, while the lowest value was in the control treatment F_0, which obtained 65.73cm. Besides, spraying alga mix extract has led to a significant increase in plant height; so, the treatment S_2 at concentration 1.5 g.L^{-1} with the highest value of 72.47cm, followed by treatment S_1 at concentration 1 g.L^{-1} significantly dominated on S_0 and reached 69.87cm, while the most negligible value was at treatment S_0 as 65.74cm. Regarding the study factors interaction, a significant effect in the trait was pronounced by achieving the treatment F_2S_2, the highest value of 75.05cm, compared to the control treatment F_0S_0, which made the most diminutive average plant height 60.11cm.

Table 2 results showed significant differences in the average increase of branch number; so, the treatment F_2 has significantly dominated the other two treatments, giving the largest number of vegetative branches as 15.13.seedling^{-1}, followed by treatment F_1 that reached 11.16 branch.seedling^{-1}, which in turn has significantly dominated on F_0 that reached 9.42 branch.seedling^{-1}. Turning to alga mix spray caused a significant increase in this trait, especially for treatment S_2 that reached 13.50 branch.seedling^{-1}, followed by treatment S_1 that reached 11.69 branch.seedling^{-1} that did not differ significantly from S_0; while the least value was at the control treatment S_0 that reached 10.52 branch.seedling^{-1}. While the interaction between both study factors has shown a significant effect in this trait via achieving the treatment F_2S_2, the highest value is 19.18 branch.seedling^{-1}, compared to control treatment F_0S_0 made the least average vegetative branches number as 9.05 branches seedling^{-1}.

Leaf Area (cm^2)

Results of Table 3 showed that study treatments had significantly influenced leaf area. So, the treatment F_2 made the largest leaf area at 22.62cm^2, followed by treatment F_1, which reached 22.05cm^2, which didn't differ significantly from the first one, while the most negligible value was with the control treatment F_0, reached 19.66cm^2. Also, spraying the alga mix caused a significant increase in leaf area, especially at treatment S_2, which came 22.47cm^2, then the treatment S_1, which reached 21.81 cm^2, which didn't differ significantly from it, while the most negligible value was at the control treatment S_0 that went 20.05cm^2. Considering the interaction between both study factors, it showed its effect in this trait through the treatment F_2S_2, which made the highest value as 23.83cm^2, while the control treatment S_0F_0 made a minor average leaf area at 17.10cm^2.

The Leaf Chlorophyll Content (mg. g^{-1} fresh weight)

Results of Table 4 showed that leaf spraying kelamyth Fe on buckthorn seedlings significantly affects leaf chloro-

Alga mix 1.5 g.L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F_0	F_1	F_2	
S_0	60.11	67.54	69.57	**65.74**
S_1	66.58	70.08	72.95	**69.87**
S_2	70.51	71.86	75.05	**72.47**
	65.73	**69.82**	**72.52**	**Average effect of Iron chelate**
LSD F*S=2.76	**LSD S=1.59**			**LSD F=1.59**

Table 1. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Average Increase of Plant Height (cm).

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F_0	F_1	F_2	
S_0	9.05	10.50	12.03	**10.52**
S_1	9.38	11.50	14.18	**11.69**
S_2	9.83	11.49	19.18	**13.50**
	9.42	**11.16**	**15.13**	**Average effect of Iron chelate**
LSD F*S=2.89	**LSD S=1.67**			**LSD F=1.67**

Table 2. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Average Number of Vegetative Branches (branch.seedling^{-1}).

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F_0	F_1	F_2	
S_0	17.10	21.74	21.32	**20.05**
S_1	20.20	22.52	22.72	**21.81**
S_2	21.68	21.90	23.83	**22.47**
	22.62	**22.05**	**19.66**	**Average effect of Iron chelate**
LSD F*S=1.81	**LSD S=1.04**			**LSD F=1.04**

Table 3. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Average Leaf Area (cm^2).

phyll content. So, the treatment F_2 especially dominated the two other treatments with 41.09 mg. g^{-1} fresh weight significant increase that differed substantially from F_1 reached 39.09 mg. g^{-1} new weight, which didn't vary significantly from F_0, while the most negligible value was with the control treatment F_0 that went 38.02 mg. g^{-1} fresh weight. Considering the alga mix spray, the table shows significant differences, especially at treatment S_2, which reached 41.20 mg. g^{-1} new weight, followed by treatment S_1, which didn't differ significantly from the latter, as it gained 39.83 mg. g^{-1} fresh importance. In comparison, the most negligible value was with treatment S_0 which reached 37.16 mg. g^{-1} new weight. Considering the interaction between both study factors, it showed its significant effect in this trait through the treatment F_2S_2 that made the highest value as 41.53 mg. g^{-1} fresh weight. In comparison, the control treatment F_0S_0 has made the most negligible chlorophyll content as 34.59 mg. g^{-1} new weight.

Leaf Total (Structural) Carbohydrate Estimation (%)

Results of Table 5 show that leaf total carbohydrate content has been influenced significantly by study treatments. So, treatment F_2 made the highest carbohydrate content at 2.42%, then treatment F_1 reached 1.91%, while the lowest value was at the control treatment F_0, which was 1.82%. Also, spraying with algal extract has caused a significant increase in leaf carbohydrate content, especially with treatment S_2, which reached 2.45%, followed by treatment S_1, which gained 1.89%, while the most negligible value was at control treatment S_0 got 1.80%. Considering the interaction between the two study factors, it showed its significant effect on this trait through the treatment F_2S_2, which made the highest value at 3.80%. In contrast, the control treatment F_0S_0 made the minor carbohydrate content at 1.45%.

Leaf Fe iron Content (ppm)

Results of Table 6 showed that leaf spraying kelamyth Fe had increased leaf Fe iron percentage; so, the treatment F_2 significantly dominated the other treatments to reach 190.66ppm. They were followed by treatment F_1, which gained 187.88 ppm, which, in turn, significantly dominated treatment F_0, which went 185.66 ppm as the small leaf Fe iron percentage. In return to alga mix spray, the table shows that treatment S_2 also significantly increased leaf Fe iron

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F0	F1	F2	
S_0	34.59	36.06	40.84	**37.16**
S_1	38.00	40.60	40.91	**39.83**
S_2	41.47	40.61	41.53	**41.20**
	38.02	**39.09**	**41.09**	**Average effect of Iron chelate**
LSD F*S=2.77	**LSD S=1.60**			**LSD F=1.60**

Table 4. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Leaf Chlorophyll Con.

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F_0	F_1	F_2	
S_0	1.45	2.23	1.73	**1.80**
S_1	2.23	1.70	1.73	**1.89**
S_2	1.77	1.79	3.80	**2.45**
	1.82	**1.91**	**2.42**	**Average effect of Iron chelate**
LSD F*S=0.78	**LSD S=0.45**			**LSD F=0.45**

Table 5. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Leaf Total (Structural) Carbohydrate Content Estimation (%).

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			Average effect of Alga mix
	F_0	F_1	F_2	
S_0	184.00	185.33	188.00	**185.77**
S_1	186.66	189.66	190.00	**188.77**
S_2	186.33	188.66	194.00	**189.66**
	185.66	**187.88**	**190.66**	**Average effect of Iron chelate**
LSD F*S=2.47	**LSD S=1.42**			**LSD F=1.42**

Table 6. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Leaf Fe Content (ppm).

percentage to 189.66ppm, followed by treatment S_1, which reached 188.77 ppm, which didn't differ considerably from S_2. In contrast, the control treatment S_0 has made the minor Fe percentage at 185.77ppm. In return, both study factors' interaction influenced this trait by making the treatment F_2S_2 the highest leaf Fe percentage as 194.00. In contrast, the control treatment F_0S_0 has reached the most negligible value at 184.00%.

Leaf Saponins Content (g.ml^{-1})

Results of Table 7 confirmed that study treatments had significantly influenced leaf saponins content. So, the treatment F_2 has made the highest saponins content at 1.21 g.ml^{-1}, dominated substantially the two other medicines, followed by treatment F_1, which reached 1.02 g.ml^{-1}, did not significantly differ from F_0, while the most negligible value was at the control treatment F_0 that was 0.96 g.ml-1. Likewi-

Alga mix 1.5 g .L^{-1}	Iron chelate (Kelamyth Fe) mg.L^{-1}			**Average effect of Alga mix**
	F_0	F_1	F_2	
S_0	0.92	1.00	1.04	**0.99**
S_1	0.97	1.03	1.05	**1.02**
S_2	0.98	1.03	1.54	**1.18**
	0.96	1.02	1.21	**Average effect of Iron chelate**
LSD F*S=0.27	LSD S=0.15			**LSD F=0.15**

Table 7. Effect of Leaf Spraying Kelamyth Fe and Alga mix and their interactions in Leaf Saponins Content (g.ml^{-1}).

se, spraying the algae mixture led to a significant increase in leaf saponin content, especially with treatment S_2, which reached 1.18 g.ml^{-1}, with a behavior similar to that of Kelamyth Fe in its effect on this trait, followed by treatment S_1, which gained 1.02 g.ml^{-1}, which did not differ significantly from S_0, while the lowest value was in the control treatment S_0, which reached 0.99 g.ml^{-1}. When we return to both study factors' interaction, it showed its significant effect on this trait by achieving the treatment F_2S_2 the highest value as 1.54 g.ml^{-1}, while the control treatment F_0S_0 has mad the most miniature leaf saponins content as 0.92 g.ml^{-1}.

Discussion

The reason for the height of the plant is due to the role of the element iron, which enters into the representation of nucleic acids, DNA and RNA necessary for cell division. It also joins as a catalyst in forming chlorophyll and enzymes that promote the construction of materials needed for the plant. Therefore, it increases the height of the plant[14]. The reason can be attributed to its role in the structure of chlorophyll. However, it did not enter in its formation, as it was found that (70%) of the total iron is present in chloroplasts, in addition to its entry in the form of cytochromes important in the process of photosynthesis. And respiration[5] explains the increase in the number of branches and leaf area and is consistent with what was found in 9 in *Hibiscus sabdariffa*, were spraying with chelated iron increased the number of components. Therefore, it agrees with (20) strawberry seedlings, cultivar Winter dawn, were spraying with chelated iron rose leaf area. Glutamate to Y-aminolevulinic acid to Y-aminolevulinic acid and the process of converting the complex Mg-protoporphyrin 1x methyl ester to Proto-chlorophyllide are two essential steps in building chlorophyll (18) that caused the increase in carbohydrate content in Buckthorn leaves when sprayed with chelated iron To the role of iron in activating the process of respiration and photosynthesis, as it participates in the formation of protein and the manufacture of chlorophyll, which has an essential role in the process of building carbon and increasing the stomata delivery of carbon dioxide, which leads to an increase in the accumulation of processed nutrients in plants that leads to the collection of carbohydrates in Leaves[12] increase in the percentage of iron in the leaves when spraying with chelated iron is due to the increase in the leaves' absorption of this element to increase its share in the spray solution and may be due in the rise in the vegetative growth of seedlings as it contributes to the chlorophyll synthesis processes[6]. The effect of seaweed extract spraying on most vegetative growth characteristics is that it contains many nutrients that play an essential role in increasing the plant's metabolic activities. Potassium activates enzymes to synthesize amino acids and proteins, as well as helps to synthesize the necessary chlorophyll in the process of photosynthesis and the formation of proteins, sugars and ATP energy compounds, leading to an increase in plant growth and size and, therefore, an increase in vegetative growth[13]. Perhaps the increase in chlorophyll content in leaves treated with seaweed extract is due to the effect of seaweed extract in inhibiting the decomposition of chlorophyll by Betaines compounds. Glycine betaines, which led to the continuation of photosynthesis as mentioned, (3) and this may be due to the marine algae extract containing organic acids that can increase the permeability of cell membranes and facilitate the transport of nutrients that have an influential role in activating metabolism for proteins and enzymes that accompany carbohydrate metabolism[22].

Conclusions

The F_2 concentration was superior in most indicators of vegetative growth and the content of mineral elements in leaves. The effect of foliar spraying with marine algae extract, especially at a concentration of 1.5 S2 g/L^{-1}, on all indicators of vegetative growth and the content of mineral elements in the leaves.

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