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Effect of aqueous extracts of the sprouted seeds on the quantitative and qualitative yield of the coral lettuce cultured under the modified nutrient solution film NFT system

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Abstract: The study was conducted at the fields of the Dept. of Horticulture and Garden Engineering, College of the Agricultural Engineering Sciences, Jadriyah in the fall season of 2020-2021 aiming to culture the coral lettuce with green and red leaves under the hydroponics system using the modified nutrient solution film NFT and study the effect of aqueous extracts of alfalfa and berseem sprouted seeds on the quantitative and qualitative yield of the lettuce crop. The research was conducted as an experiment of split plots within the Randomized Complete Block Design (RCBD) of three replicates. The seedlings of the green coral lettuce, Locarno RZ, and red coral lettuce, Locarno RZ, symbolized by A and B respectively, were transferred to the culture system on 1/10/2020. Lettuce hybrids were regarded as the less important factor (main plot). The plants were sprayed with aqueous extracts of the alfalfa sprouted seeds at the two concentrations of 5 and 10%, symbolized by T1 and T2, and with aqueous extracts of the berseem sprouted seeds at the two concentrations of 5 and 10%, symbolized by T3 and T4, respectively, in addition to the control treatment (spraying with distilled water only), symbolized by T0. They were sprayed to full wetness three times at an interval of 10 days. This was regarded as the most important factor (subplot). Each experimental unit contained 10 plants. Results showed significant superiority of the treatment AT2 in the leaf chlorophyll content, number of leaves, leaf area and dry weight of vegetative growth (80.00 mg.100g fresh weight^{-1}, 37.00 leaf.plant^{-1}, 144.05 dcm^{2}.plant^{-1}, 10.97 g.plant^{-1} respectively) compared to the lowest value of the treatment BT0 (60.56 mg.100g fresh weight^{-1}, 19.00 leaf.plant^{-1}, 63.32 dcm^{2}.plant^{-1} and 5.65g.plant^{-1} respectively). The same treatment (AT2) was superior in the highest root dry weight, and plant yield amounted to 1.92 and 364.35g.plant^{-1}, respectively compared to the lowest values at the treatment AT0, recording 0.75 and 219.92g.plant^{-1} respectively. The interaction treatments' effect was insignificant on the content of β-carotene and VC in the leaves. We concluded that it is possible to culture the coral lettuce hydroponically and increase its productivity through spraying with the aqueous extracts of the alfalfa sprouted seeds at the concentration of 5%, which did not record a significant difference in the production from the treatment of spraying with aqueous extracts of the alfalfa sprouted seeds at 10%.

Key words: *Lactuca sativa* L., Red lettuce, Organic nutrients, Plant extracts, Soil culture.

Introduction

The production of vegetables by hydroponics is increasing rapidly with the increased interest in consuming high-quality, fresh local foods throughout the year. Among the various hydroponic systems, producing leafy green vegetables using NFT is the most common practice in this system[1,2], where the nutrient solution is continuously cycled to replenish nutrients and oxygen dissolved during the production cycle.

Lettuce (*Lactuca sativa* L.), which belongs to the family Compositae, is one of the most important vegetables grown mainly by this technique due to its consumption in large quantities. It is an essential source of anti-oxidants, in addition to its great activity in eliminating free radicals and preventing many chronic diseases such as cancer and heart and blood vessel diseases[3]. Lettuce also has a high nutritional value and rapid growth, as it contains proteins, mineral salts, and vitamins, the most important of which are VC, V.B9, and VA[4] It is considered a tranquilizer, and it is recommended to eat in the case of insomnia and before bed because of its content of Lactucarium. Lettuce is divided into several groups, including asparagus lettuce (*Lactuca sativa* var. aspargina Baiby), leafy lettuce (*Lactuca sativa* var. crispa L.), Iceberg lettuce (*Lactuca sativa* var.capitata L.), and Romaine lettuce (*Lactuca sativa* var.longifolia L.) The leaves in all these groups are simple, but they may completely wrap around the terminal bud, forming fused heads as in Iceberg lettuce, or the leaves grow outside without covering, as in asparagus and coral lettuce[5]. In a study conducted on lettuces of green-leaf and red-leaf cultured hydroponically, (6) found that genetic factors significantly affect the yield, biomass, and quality of the lettuce crop.

The quantity and quality of production depend on the fertilization during growth, so another trend has emerged in the plant nutrition domain aiming to use plant extracts containing some substances that encourage the growth process to increase plant productivity and maintain consumer health and environmental cleanliness, as these extracts are agricultural and chemical tools that encourage plants

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to present higher physiological and hereditary performance, which is reflected on the nature of the plant growth and yield as one of the safe, natural alternatives to obtain the best production per area unit[7]. (8) found that when spraying beet plants with aqueous extracts of five seed species, anise aqueous extract at the concentration of 50g.l^{-1} affected the root weight significantly, productivity per unit area, TSS of root content, and sucrose. (9) she reported spraying cauliflower with aqueous extract of the dry fava bean seeds at the concentration of 2.5g.l^{-1} gave the highest weight of curds and total plant yield.

Recently, the trend was to study the use of the aqueous extracts of sprouted seeds, which are characterized by their richness in substances in a simple formula and easy absorption and low content of ABA and rich source of natural hormones, vitamins, nutrient elements and saccharides and amino acids[10]. (11) indicated spraying aquatic extract of barley seeds 100g dry seeds.l^{-1} significantly affected vegetative and qualitative parameters of carrot roots and yield increment compared to the control treatment. (12) referred that spraying the aqueous extract of the sprouted barley seeds at an amount of 100g dry seeds.l^{-1} on the carrot plants affected the anti-oxidants of total carotenoids and beta carotenoids and the percentage of sweep DPPH in carrot roots significantly, compared to the control treatment. Therefore, the objective of the research was to culture the coral lettuce with green and red leaves under the hydroponics system using the modified nutrient solution film NFT and study the effect of aqueous extracts of alfalfa, and clover sprouted seeds on the quantitative and qualitative yield of the lettuce crop.

Materials and methods

The study was conducted in the fields affiliated with the Department of Horticulture and Garden Engineering, College of Agricultural Engineering Sciences, Jadriyah, during the fall of 2020-2021. Seedlings of LOCARNO RZ green lettuce and Concorde RZ red lettuce produced by the Holland RIJK ZWAAN company were transferred to the hydroponic system with modified nutrient solution film technology NFT on 1/10/2020, which were symbolized by A and B, respectively. The standard nutrient solution nourished the plants Copper (1979)[13]. The plants were sprayed with extracts to total wetness three times at an interval of 10 days. The extracts are aqueous extracts of sprouted alfalfa seeds (*Medicago sativa* L.) at the concentrations of 5 and 10 %, symbolized by T1 and T2 respectively, and aqueous extracts of berseem seeds (*Trifolium alexandrinum* L.) at the concentrations of 5 and 10%, represented by T3 and T4 respectively, in addition to the control treatment (spraying with distilled water only), symbolized by T0. Table 1 shows the components of aqueous extracts of sprouted seeds used for spraying research plants. The research was conducted as an experiment of split plots within the Randomized Complete Block Design (RCBD) involving three replicates. The lettuce hybrids were considered less important and included in the main plots, while the spray treatments constituted the sub-plots. Each experimental unit contained 10 plants.

The leave content of nitrogen was determined using the Kjeldahl Micro[14] device, the leaf's range of phosphorous was determined using the ammonium molybdate and ascorbic acid using a spectrophotometer at a wavelength of 620 nm, and the leaf content of potassium using the Atomic Absorption device[15]. Also, the leaves content of chlorophyll in the dye was estimated according to Goodwin and then converted to mg.100 g fresh weight^{-1} [16]. Leaves number (leaf. plant^{-1}) were measured at the end of the season. The leaves area (dcm^2. plant^{-1}) was calculated using the dry weight method by (17). The dry weight of vegetative growth (g.Plant^{-1}) was measured at the end of the season, then the roots of the selected plants were dried in Oven at 65-71C, then the dry weight (g.Plant^{-1}) was calculated using a sensitive scale. Also, β-carotene was extracted and calculated (mg 100g^{-1} fresh weight) according to (18). The leaves juice filtrate was calibrated with the dye (2.6, Dichlorophenol Indophenols) described in (19) to calculate the concentration of Ascorbic acid (VC) (mg 100 g^{-1} fresh weight). The nitrate was estimated (mg 100 g^{-1} dry weight) according to (20), The red lettuce content of anthocyanin was calculated according to the method of (21).

Results

Results in Table 2 showed the significant superiority of the green leaf of cord lettuce (A) in the chlorophyll and P contents, the number of leaves, total leaf area, dry weight of the shoot system, and dry weight of the root system that they were 0.65%, 76.68mg.100g fresh weight^{-1}, 30.60 leaf. plant^{-1}, 118.90dcm^2.plant^{-1}, 9.14g and 1.64g.plant^{-1}, respectively compared to the red leaf lettuce (B), recording 0.63%, 72.40mg.100g fresh weight^{-1}, 30.60 leaf.plant^{-1}, 113.31dcm^2. plant^{-1}, 7.47g.plant^{-1} and 1.46g.plant^{-1} respectively. Green and red leaf lettuce (A and B) did not differ significantly in their content of N and K. The treatments of spraying sprouted seeds' aqueous extracts significantly affected the studied traits. The treatments of spraying sprouted seeds' aqueous extracts significantly affected the studied traits. Spraying with aqueous extract of sprouted alfalfa seed at 10% (T2) significantly increased the leaf contents of K and chlorophyll, number of leaves, total leaf area, dry weight of the shoot system and dry weight of the root system, attaining 4.45%, 78.48mg.100g fresh weight^{-1}, 32.50 leaf.plant^{-1}, 138.53dcm^2.plant^{-1}, 10.09g.plant^{-1} and 1.76g.plant^{-1} respectively, which did not differ significantly from T4 or T3 in the leaf content of K from T1 or T4 in the leaf content of chlorophyll, nor T3, T1, or T4 in root dry weight; however, they differed from the control treatment (T0) that recorded 3.82%, 66.23mg.100g fresh weight^{-1}, 22.00 leaf.Plant^{-1}, 72.26 dcm^2. plant^{-1}, 6.01g.plant^{-1}, and 1.03g.plant^{-1} respectively. Spraying with the sprouted berseem seeds extract at the concentration of 5% (T3) increased the N content in the leaves

Aqueous extracts of the sprouted seeds	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu	B
				mg L^{-1}						
Alfalfa 10%	490	11	1400	1000	160	3.1	2.6	1.5	3.3	70
berseem 10%	840	18.5	2050	1500	290	25.3	4.2	2.9	3.3	105

Table 1. Chemical analysis of the sprouted seeds' aqueous extracts used in the research.

Treatment	N	P	K	Chlorophyll	No. of Leaves	Leaf area	The dry weight of the plant	The dry weight of the root
	%			mg.100g fresh wt.$^{-1}$	Leaf. plant^{-1}	dsm^2. plant^{-1}	g.plant^{-1}	g.plant^{-1}
A	4.53	0.65	4.20	76.68	30.60	118.90	9.14	1.64
B	4.51	0.63	4.26	72.40	25.40	113.31	7.47	1.46
LSD 0.05	N.S	0.01	N.S	3.88	1.73	3.88	1.36	0.15
T0	4.24	0.55	3.82	66.23	22.00	72.26	6.01	1.03
T1	4.58	0.64	4.17	77.88	28.00	122.37	8.19	1.66
T2	4.59	0.68	4.45	78.48	32.50	138.53	10.09	1.76
T3	4.62	0.64	4.34	74.69	28.50	115.61	8.54	1.71
T4	4.59	0.69	4.37	75.45	29.00	131.77	8.68	1.58
LSD 0.05	0.10	0.04	0.12	3.57	2.28	6.58	1.29	0.22
AT0	4.20	0.55	3.89	71.90	25.00	81.20	6.37	0.75
AT1	4.65	0.67	4.13	79.80	31.00	122.66	10.05	1.86
AT2	4.51	0.68	4.30	80.00	37.00	144.05	10.97	1.92
AT3	4.61	0.63	4.16	74.63	30.00	110.34	9.86	1.90
AT4	4.72	0.72	4.55	77.10	30.00	136.27	8.45	1.77
BT0	4.29	0.55	3.75	60.56	19.00	63.32	5.65	1.31
BT1	4.51	0.62	4.22	75.96	25.00	122.08	6.34	1.46
BT2	4.67	0.69	4.61	76.96	28.00	133.02	9.22	1.61
BT3	4.64	0.65	4.53	74.76	27.00	120.88	7.23	1.53
BT4	4.46	0.66	4.20	73.80	28.00	127.28	8.91	1.40
LSD 0.05	0.14	N.S	0.16	4.87	2.98	8.48	1.75	0.29

Table 2. Effect of aqueous extracts of the sprouted seeds on chemical analysis and vegetative parameters of coral lettuce cultured hydroponically in the fall season 2020-2021.

to 4.62%, which did not differ significantly from T4, T2, or T1 compared to the control treatment (T0) recording 4.24%. The treatment of spraying with the sprouted berseem seeds extract at the concentration of 10% (T4) also affected significantly the P content in the leaves to be 0.69%, which did not differ significantly from T2, compared to the lowest content in the leaves (0.55%) obtained from the control treatment (T0). The interaction between the two study factors significantly affected the cultured lettuce plants' studied chemical and vegetative traits. The treatment of spraying the green lettuce plants with 10% of the sprouted berseem seeds extract (AT4) was superior in the N content of the leaves, recording 4.72% that did not differ significantly from BT2, AT1, BT3, or AT3 in comparison to the lowest N content 4.20% recorded by AT0. The treatment of red lettuce sprayed with 10% of the sprouted alfalfa extract (BT2) was superior in the leaf K content, recording 4.61%, not differing significantly from AT4 or BT3, compared to the lowest K content obtained from BT0 of 3.75%. On the other hand, the treatment of the green lettuce sprayed with the sprouted alfalfa seed extract at the concentration of 10% (AT2) was superior in the leaf chlorophyll content, the number of leaves, leaf area, root dry weight, and shoot dry weight that recorded 80.00mg.100g fresh weight^{-1}, 37.00 leaf.plant^{-1}, 144.05 dcm^2.plant^{-1}, 10.97g. pant^{-1} and 1.92g.plant^{-1} respectively which did not differ significantly from the treatment AT1, AT4, BT2 or BT1 in the leaf chlorophyll content, from AT4 in the leaf area, nor AT1, AT3, BT2 in the root dry weight, compared to the lowest values of chlorophyll content, number of leaves, leaf area and shoot system dry weight that were obtained from BT0 recording 60.56mg.100g fresh weight^{-1}, 19.00 leaf.plant^{-1}, 63.32 dm^2.plant^{-1} and 5.65g.plant^{-1} respectively. AT0 treatment gave the lowest dry weight of the root system, 0.75g.plant^{-1}.The interaction treatments did not affect the P content in the leaves significantly.

Table 3 showed the significant superiority of green-leaf coral lettuce (A), giving the highest yield per plant and β-carotene and the lowest nitrate content, recording 308.06g. plant^{-1}, 7.62 mg.100fresh weight^{-1} and 8.09mg.100 dry weight^{-1} respectively compared to the red-leaf lettuce (B) that

Treatment	Yield of plant	β-carotene	VC	Nitrate
	g.plant-1	mg 100 g-1 fresh weight		mg 100 g-1 dry weight
A	308.06	8.09	55.12	0.57
B	276.16	7.62	55.60	0.68
LSD 0.05	31.12	0.21	NS	0.02
T0	229.90	7.33	41.62	0.28
T1	300.05	7.75	54.42	0.60
T2	338.58	8.15	65.75	0.69
T3	297.62	8.08	50.75	0.74
T4	294.43	7.97	64.25	0.83
LSD 0.05	34.71	0.29	16.55	0.04
AT0	219.92	7.52	40.75	0.22
AT1	341.51	8.21	58.10	0.51
AT2	364.35	8.33	68.00	0.65
AT3	317.71	8.28	43.50	0.72
AT4	296.85	8.12	65.25	0.78
BT0	239.88	7.15	42.50	0.35
BT1	258.59	7.30	50.75	0.70
BT2	312.82	7.97	63.50	0.73
BT3	277.53	7.89	58.00	0.77
BT4	292.02	7.82	63.25	0.89
LSD 0.05	46.09	NS	NS	0.05

Table 3. Effect of aqueous extracts of sprouted seeds on plant yield and quality parameters of the coral lettuce grown hydroponically in the fall season 2020-2021.

recorded 276.16 g. plant^{-1}, 7.62 mg.100 g fresh weight^{-1} and 0.68 mg.100 g dry weight^{-1} respectively. The plants of the green-leaf and red-leaf (A and B) did not differ significantly in their content of VC. The treatments of spraying with aqueous sprouted seeds extracts had a significant effect on the same traits, as the treatment of spraying with aqueous extracts of sprouted alfalfa seeds at 10% (T2) gave the highest plant yield, leaf content of β-carotene and VC amounted to 338.58 g.plant^{-1}, 8.15 and 65.75 100 mg fresh weight^{-1} respectively, which did not differ significantly from treatment T3 or T4 in the leaf content of β-carotene and from treatment T4, T1 or T3 in the leaf content of VC compared to the control treatment (T0), which gave the lowest plant yield and the lowest leaf content of β-carotene and VC were 229.90 g.plant^{-1}, 7.33 and 41.62 mg.100g fresh weight^{-1} respectively. The control treatment (T0) with the lowest content of nitrate in its leaves was 0.28 mg.100 g dry weight^{-1} was superior compared to the highest content in the treatment of spraying with aqueous extract of sprouted berseem seeds at 10% (T4) which was 0.83 mg.100g dry weight^{-1}. The effect of the interaction between the coral lettuce hybrids and spraying with aqueous extracts of the sprouted seeds was significant in the plant yield. The treatment AT2 produced the highest yield, amounting to 364.35 g.plant^{-1}, which did not differ from AT1 compared to the lowest lettuce plant yield of 219.92g.plant^{-1} recorded by AT0, which recorded the lowest nitrate content in the leaves was 0.22mg.100g dry weight^{-1}, the interaction between the two studied factors was insignificant on the lettuce contents of β-carotene or VC.

Saccharides are produced through the photosynthesis process in the source and consumed in growth, storage,

Treatment	BT0	BT1	BT2	BT3	BT4	LSD 0.05
Anthocyanin mg 100 g^{-1} fresh weight	27.22	29.77	38.55	32.07	35.15	7.13

Table 4. Effect of aqueous extracts of the sprouted seeds on the Anthocyanin content in leaves of the red coral lettuce cultured hydroponically in the fall season 2020-2021.

and reproduction in the sink according to mechanisms that are the main determinants of plant productivity, response to environmental changes, and genetic efficiency in using inputs[35]; therefore, the green lettuce superiority in giving the highest yield may be attributed to constitution a robust root system represented by the dry root weight as a result of phosphorus increment (Table 2) which enhanced nutrients absorption throughout the growing season and then increased the materials manufactured in the process of photosynthesis, which was positively reflected on the vegetative growth indicators as an increase in the number of leaves, leaf area, and dry weight, as well as the increase in the concentration of total chlorophyll in the leaves, which increased the efficiency of the plant, and eventually increased the total yield (table 3). Also, the disintegration of sugars resulting from the capon assimilation process forms Acetyl COA, which represents the basic material in the manufacturing of beta-carotene[36]. The low concentration of nitrates in green lettuce, which the world aspires to by reducing residues in food products, may be due to the superiority of this hybrid in giving good vegetative growth (Table 2) and the highest plant yield (Table 3), which led to the nitrates dilution, lowering their concentration, and non-accumulation. The increase in the plant yield justifies the encouraging positive effect of the elements and the integrated system achieved when spraying with aqueous nutrients that are low in cost and do not pollute the environment. Starting with nitrogen, which improves the quality and productivity of crops, similar to phosphorous, it passes through potassium, distinguished by its ability to enhance the product quality and increase the leaf's effectiveness in producing nutrients. These extracts contain water-soluble organic compounds such as organic and amino acids, sugars and proteins, which directly contribute to the plant growth and development for the content of the nutrients that the plant needs, as they increase the plant enzymatic and hormonal activity, leading to increasing the production and improving its quality[37]. They also have a role in manufacturing pigments such as β-carotene[38] and raising the efficiency of the carbon assimilation process and its products, including D-Glucose, the initiator of VC formation[39,40]. On the other hand, increasing the nitrate concentration as a result of spraying with an aqueous extract of sprouted clover seeds at 10% may be due to its high nitrogen content and to this treatment behavior in absorbing large quantities of it and then accumulating it in its tissues, knowing that it is within the safe and non-toxic limits for humans. It is possible to grow lettuce slit in nutrient solutions and obtain a healthy product, as the moderate content of nitrates is within 500-1000 mg kg of fresh weight^{-1} [41].

The results of the interaction between the study factors are due to increasing the carbon assimilation products where the plant took advantage of the availability of appropriate environmental conditions of energy and nutrients to increase its productivity and improve the quality of its traits.

Results listed in Table 4 illustrated the superiority of the treatment T2, giving the highest anthocyanin content in the leaves of the red lettuce, amounting to 38.55mg.100fresh weight^{-1}, which did not differ significantly from T4 or T3, compared to the lowest content of this pigment found in T0, recording 27.22mg.100fersh weight^{-1}.

Discussion

The reason for the increase in P content in the green lettuce leaves compared to the red lettuce may be due to the different responses of the hybrids to the growth factors according to the genetic structure as well as to the interaction between the genotype and environmental factors[22,23]. Increasing phosphor concentration increases energy compounds and stimulates enzyme action[24], especially proteins contributing to building chlorophyll molecule[25] that reflects on the chlorophyll content in the leaves, leading to an increase in the photosynthetic products that results in increasing the vegetative growth size including the number of leaves and leaf area, increasing the chlorophyll pigment means increasing the carbon assimilation, as it is considered the direct location for harvesting the light energy to be converted into biological energy within a plant[26]. It would increase the accumulated manufactured substances, such as carbohydrates and proteins, and then increase the dry weight of the vegetative growth[27]. Translocating the carbon assimilation products to different plant parts increases the root system. Then, it increases the root's dry weight, which may be due to the plant content of nutrients, primarily N and P, combined in increasing the roots' surface area, mass, and length[28]. A considerable root system helps plants to obtain more excellent nutrients. In contrast, plants with large shoot systems harvest a more significant amount of light energy and then manufacture a higher amount of carbohydrates in carbon assimilation due to the influence of internal genetic factors and external factors, the most important of which are nutrition and surrounding environmental conditions[29,30].

The reason for increasing the content of nutrients in the leaves and enhancing the vegetative traits of the coral lettuce sprayed with 10 % the aqueous extract of the alfalfa sprouted seeds may be due to the excellent and balanced content of nutrients (Table 1) as well as providing them with as a soluble and ready-to-absorb manner, especially nitrogen (in the form of amino acids and primary peptides) and phosphorous (in the form of soluble phosphates) as a result of seed culturing that makes them available biologically to be absorbed quickly and increasing their percentage within the leaves, and then increasing the plant growth and development represented by an increase in the number of leaves and the green leaf area that captures the light to perform carbon assimilation, followed by increasing the accumulating the dry matter of the shoot and root systems together, especially since the two elements, nitrogen and phosphorus participate in constructing proteins, enzymes, and amino acids which stimulate the formation of cytokinins, which in turn encourages the rapid division of cells and their construction, which is reflected on the vegetative growth traits[31,32]. Phosphorus may also provide the energy needed to constitute new cells, which increases plant growth and development[33]. Potassium may encourage the act of enzymes, the translocation of carbon assimilation products, and its role in cell division and elongation[34].

The reason for the superiority of the interaction treatments for the hydroponically grown lettuce plant may be due to the integration of genetic factors with organic nutrients in improving the nutritional status of the plant, which was reflected in its growth and development through its impact on various biological processes such as cell division, hormonal balance and carbon assimilation that are embodied in the significant increase in the vegetative indicators of the plant.

Saccharides are produced through the photosynthesis process in the source and consumed in growth, storage, and reproduction in the sink according to mechanisms that are the main determinants of plant productivity, response to environmental changes, and genetic efficiency in using inputs[34]; therefore, the green lettuce superiority in giving the highest yield may be attributed to constitution a robust root system represented by the dry root weight as a result of phosphorus increment (Table 2) which enhanced nutrients absorption throughout the growing season and then increased the materials manufactured in the process of photosynthesis, which was positively reflected on the vegetative growth indicators as an increase in the number of leaves, leaf area, and dry weight, as well as the increase in the concentration of total chlorophyll in the leaves, which increased the efficiency of the plant, and eventually increased the total yield (table 3). Also, the disintegration of sugars resulting from the capon assimilation process forms Acetyl COA, which represents the primary material in the manufacturing of beta-carotene[35]. The low concentration of nitrates in green lettuce, which the world aspires to by reducing residues in food products, may be due to the superiority of this hybrid in giving good vegetative growth (Table 2) and the highest plant yield (Table 3), which led to the nitrates dilution, lowering their concentration, and non-accumulation. The increase in the plant yield is perhaps the encouraging positive effect of the elements and the integrated system achieved when spraying with aqueous nutrients that are low in cost and do not pollute the environment. Nitrogen, which improves the quality and productivity of crops, like phosphorous, passes through potassium, distinguished by its ability to enhance the product quality and increase the leaf's effectiveness in producing nutrients. These extracts contain water-soluble organic compounds, such as organic and amino acids, sugars and proteins, which directly contribute to the plant growth and development for the content of the nutrients that the plant needs, as they increase the plant enzymatic and hormonal activity leading to increasing the production and improving its quality[36]. They also have a role in manufacturing pigments such as β-carotene[37] and raising the efficiency of the carbon assimilation process and its products, including D-Glucose, the initiator of VC formation[38,39]. On the other hand, increasing the nitrate concentration as a result of spraying with an aqueous extract of sprouted clover seeds at 10% may be due to its high nitrogen content and to this treatment's behavior in absorbing large quantities of it and then accumulating it in its tissues, knowing that it is within the safe and non-toxic limits for humans. It is possible to grow lettuce slit in nutrient solutions and obtain a healthy product, as the moderate content of nitrates is within 500-1000 mg kg of fresh weight^{-1} [40].

The results of the interaction between the study factors are due to increasing the carbon assimilation products where the plant took advantage of the availability of appropriate environmental conditions of energy and nutrients to increase its productivity and improve the quality of its traits.

The superiority of the treatment of spraying with aqueous extract of alfalfa seeds at 10% (T2) in increasing the Anthocyanin content in the leaves may be due to increasing their effect on enhancing the plant vegetative growth (Table 2) and increasing the products' effectiveness of carbon assimilation which reflect positively as an increase in the secondary metabolism and its products involving the Anthocyanin pigment that differs accordingly with cultivar difference and environmental conditions.

Conclusions

We concluded that it is possible to culture the coral lettuce hydroponically and increase its productivity through spraying with the aqueous extracts of the alfalfa sprouted seeds at the concentration of 5%, which did not record a significant difference in the production from the treatment of spraying with aqueous extracts of the alfalfa sprouted seeds at 10%.

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