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Article

The Effect of Natural Extracts and Tea Compost on the Vegetative Growth of Carnation Plants Stressed by Heavy Elements

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Annotation: A factorial experiment was carried out in the greenhouses that were implemented for this purpose to study the ability of the accumulation and resistance of the carnation plants to growth in soil contaminated with toxic elements and plant treatment using natural extracts and treatment with different ratio of biological organic aquatic extracts. The experiment included the use of three factors, the first factor included treating the plants with two types of extracts (licorice root and malt seed) in addition to the control treatment, while the second factor included treating the planting soil with two ratio of tea compost (1/5 and 1/10), while the third factor included treating the potting soil with heavy elements. Copper, lead and their mixture at a concentration of 5 mg L-1, follow the design of C.R.D. In the study experiment, there were three replicates, and each replicate included 3 experimental units. The results of the study showed that the study factors had a significant effect on the studied vegetative growth characteristics. The triple interaction treatment (licorice extract and 5/1 ratio of tea compost for non-stressed plants) had a significant superiority in plant height, number of leaves, number of vegetative branches, and chlorophyll content of leaves with an average of (23.67cm, 64.33 leaves, 11.33 branches, and 42.00 SPAD), while the treatment (spraying unstressed plants with licorice extract without adding tea compost) achieved the highest average dry weight of vegetative growth, with an average of 11.816 gm.

Keywords: tea compost, licorice extract, malt extract, heavy elements

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1. Introduction

Carnation belong to the caryophylaceae family, whose plants grow in the temperate region of the northern hemisphere. This family includes 2,100 species and 89 genus, and the genus Carnation contains approximately 300 species that grow in Europe, Asia, and North Africa [27]. Carnation are grown in ponds, gardens or In pots, its wide use is as cut flowers, as cut flowers have become one of the commercial symbols in global trade. Many countries compete in the main production of cut flowers, and the United States of America and the countries of the Mediterranean basin are the main regions for producing carnations in the world. Carnation come in third place after roses and Chrysanthemum plants in production [1], [2]. In their external surroundings, plants are exposed to various biotic and non-biotic stresses, the harmful effects of which appear on the plant, the stress force is often measured by the survival of the plant, the abundance of the crop, or the processes of fixing CO_2 and taking in the elements to which plant growth is linked.

Heavy elements stress is one of the abiotic stresses that includes highly toxic elements. In the past few years, heavy elements have received great attention as a result of the increasing manifestations of environmental pollution due to agriculture, industry, energy, local waste, and sewage [3]. Various strategies have been employed to mitigate pollution and embrace sustainable agriculture practices that minimize the accumulation and dissemination of chemicals. These approaches include the adoption of safe alternatives, such as the incorporation of natural extracts to fulfill essential nutritional requirements for plant growth. Additionally, the utilization of biological organic mixtures in agriculture, such as tea compost, which serves as a microbial inoculum in the form of an aqueous solution containing significant quantities of microscopic organisms' extract derived from fermented organic fertilizer and soluble chemical compounds in the form of macro and micronutrients, has been implemented. This method aims to diminish the accumulation of fertilizer waste, mitigate the decline in biodiversity, and enhance soil fertility. Prepared with the objective of improving soil properties and promoting root growth, tea compost simultaneously reduces the economic costs of agriculture by diminishing reliance on conventional fertilizers, establishing itself as a valuable source of organic mineral plant nutrition [4], [5]. The current study aims to increase the growth productivity of carnation plants and study their ability to bio treat heavy elements using the principles of clean agriculture, including the use of natural extracts and bio-organic mixtures.

2. Materials and Methods

An factorial experiment was carried out in a plastic house designated for this purpose for the period extending from June 2022 to March 2023. The aim of studying the ability of the accumulation and resistance of the carnation plant to growth in soil contaminated with toxic elements and plant treatment using natural plant extracts and treatment with different proportions of bio-organic aqueous extracts. Carnation seeds were planted on 10/15/2022, and after four true leaves appeared, the seedlings were separated and planted in plastic pots with a capacity of 5 kg and a diameter of 30cm, following C. R.D. with three replications and three factors, as follows:

1) The first factor: Two types of natural plant extracts were used depending on their plant source, in addition to the control treatment as foliar spray treatments, with three spraying periods and a time difference of 15 days between each spray and the next, starting from the first spray, as follows: extract of licorice roots and barley grains at a concentration of 100% ml L-1. Licorice extract was prepared after plant collection was completed using the aqueous extraction method according to the method described by Harbrne [28].
2) The Second factor: two ratios of tea compost were used in addition to the control treatment as a ground additive with three addition periods (Tea Compost ratio means the amount of fermented organic matter to the volume of water in a 100 liter container). As follows, treatment with water only and treatment in ratio of 1/5 and 1/10. Decomposed organic materials of plant origin were collected from organic farms on June 25, 2022. They were cleaned and then packed under a black polyethylene cover for 75 days to ensure their complete decomposition, with continuous stirring and detection and quantities of industrial molasses were added every 15 days through the accumulation period. Plastic barrels of 120 liters were then prepared and filled with twice-distilled, chlorine-free water, according to the proportions shown above. The planting pots were treated by adding the above extract according to the prepared proportions to the soil three days before the separation process was carried out to ensure homogeneity of the soil with the solution, and only once.
3) The Third factor: The agricultural soil was contaminated with heavy elements before starting to spread the seedlings as follows: planting in natural mixed soil, adding lead and copper and their mixture at a concentration of 5 mg L-1. The heavy metals were added in the form of solutions according to the proven concentrations in equal quantities to the planting pots after dissolving them in 1 liter of water, then they were added in one batch, mixing with the soil. This process took place 15 days before planting the seedlings to ensure a homogeneous distribution of the elements in the potting soil.

2.1. The Parameters

1) Plant height (cm): Measure from the point where the plant connects with the soil of the pot to the top of the plant.
2) Number of leaves (plant leaf-1): The number of leaves for each plant was calculated from the replicate.
3) Number of vegetative branches (plant branch-1): The number of leaves for each plant was calculated from the replicate.
4) Dry weight of the shoot (gm): One plant from each replicate was taken randomly and the root shoot was separated from it. After washing it well with water to remove dust, the wet weight was measured, then dried in an electric oven at a temperature of 70°C until the weight was constant. Then, the dry weight of each plant was measured using a sensitive balance, and the average was extracted.
5) Leaves' total chlorophyll content (SPAD): It was calculated at the flowering stage as an average of five readings for each experimental unit using a Japanese SPAD 502 device [6].

3. Results

3.1. Plant height (cm):

The data in Table 1 indicate that there are significant differences in the characteristics of plant height due to the effect of treatment with different types of natural extracts sprayed on the shoots, as the treatment sprayed with licorice was significantly superior to the control treatment only by achieving the highest average of 19.22 cm without differing significantly from the extract treatment, Malt recorded 19.19 cm, while the lowest average was recorded in the control treatment, which to 16.53 cm. As for the effect of tea compost, the results of the same table showed that there were significant differences in the above-mentioned characteristic resulting from treating the plants with different ratio of the mixture, as the 1/5 treatment achieved a significant effect on the other treatments by recording the highest average of 19.19 cm compared to the control treatment that achieved the lowest average is 17.50 cm.

The results of the table indicated that stress with heavy elements had a significant effect, the control treatment achieved the highest average of 20.56 cm, outperforming the other treatments, while the heavy elements mixture treatment recorded the highest average of 20.56 cm for carnation plants compared to the treatment of the mixture with heavy elements, which recorded the lowest average for these treatments. The characteristic reached 16.96 cm without significantly differing with the stress treatment with copper, which achieved an average of 17.44 cm.

According to the results, the di interactions between the experimental factors caused a significant difference in the plant's height, the interaction of spraying with natural extracts and adding tea compost to the potting soil achieved a significant response, represented by the interaction of the malt extract with the ratio 1/5, which recorded an average of 20.42 cm, while the lowest average was achieved in the control treatment with an average of 15.67 cm, as for the interaction between spraying plant extracts and stress treatments, the interaction of the licorice extract treatment with non-stressed plants resulted in a significant increase in plant height with the highest average reaching 22.11 cm, in contrast to the treatment not spraying with the natural extract and stressed with copper only, which gave the lowest average of 15.33cm. The results of the same table showed that there were significant differences caused by the interaction of adding tea compost to the pots of plants stressed with heavy elements, as the interaction treatment of 1/5 for non-stressed plants recorded a significant superiority over the rest of the treatments by achieving the highest average of 22.00 cm compared to the interaction of spraying with water only for the plants stressed with copper only, which recorded the lowest average of 16.44 cm.

Table 1. Effect of natural extract and tea compost and their interaction on the height of carnation plants (cm) stressed by heavy elements

Extract	*Tea compost*	*Heavy Elements*				*Extract × Heavy Elements*
		Non	*Cu*	*Pb*	*Pb + Cu*	
Non	***Non***	17.00	14.67	16.67	14.33	15.67
	1/5	19.67	15.67	18.33	16.00	17.42
	1/10	18.33	15.67	16.00	16.00	16.50
Malt	***Non***	20.33	16.33	17.33	18.33	18.08
	1/5	22.67	19.67	20.33	19.00	20.42
	1/10	20.67	19.33	19.67	16.67	19.08
Licorice	***Non***	21.33	18.33	18.00	17.33	18.75
	1/5	23.67	19.67	18.33	17.33	19.75
	1/10	21.33	17.67	20.00	17.67	19.17
L.S.D. 0.05			3.274			1.637
		Extract × Heavy Elements				*Extract*
Non		18.33	15.33	17.00	15.44	16.53
Malt		21.22	18.44	19.11	18.00	19.19
Licorice		22.11	18.56	18.78	17.44	19.22
L.S.D. 0.05			1.890			0.945
		Tea compost × Heavy Elements				*Tea compost*
Non		19.56	16.44	17.33	16.67	17.50
1/5		22.00	18.33	19.00	17.44	19.19
1/10		20.11	17.56	18.56	16.78	18.25
L.S.D. 0.05			1.890			0.945
Heavy Elements		20.56	17.44	18.30	16.96	
L.S.D. 0.05			1.091			

The interaction of the three factors of the study together had a significant effect on plant height. Plants treated with a spray with licorice extract and the addition of tea compost at a ratio of 1/5, not stressed with heavy elements, recorded the highest average of 22.67 cm, while carnation plants not sprayed with extracts, not treated with tea compost, and stressed, with a mixture of heavy elements, the lowest average for this characteristic was 14.33 cm.

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

The results of Table 2 showed that natural extracts and tea compost did not significantly affect the number of leaves. While the results showed that the heavy elements had a significant effect, the control treatment recorded the highest average of 62.11, thus being significantly superior to the other treatments, while the mixture treatment with heavy elements recorded the lowest average for this trait 47.59 leaves.

Table 2. Effect of natural extract and tea compost and their interaction on the number of leaves of carnation plants stressed by heavy metals

Extract	***Tea compost***	***Heavy Elements***				***Extract × Heavy Elements***
		Non	***Cu***	***Pb***	***Pb + Cu***	
Non	***Non***	63.67	57.33	53.67	46.33	55.25
	1/5	66.67	59.33	52.67	46.67	56.33
	1/10	62.00	55.00	55.00	50.33	55.58
Malt	***Non***	63.33	54.00	56.00	48.00	55.33
	1/5	61.33	57.33	52.67	45.33	54.17
	1/10	59.00	53.00	54.67	46.67	53.33
Licorice	***Non***	59.33	49.67	57.67	48.33	53.75
	1/5	64.33	53.00	56.00	52.67	56.50
	1/10	57.33	54.00	51.00	44.00	51.58
L.S.D. 0.05		9.655				4.827
	Extract × Heavy Elements					***Extract***
Non		64.11	57.22	53.78	47.78	55.72
Malt		61.22	54.78	54.44	46.67	54.28
Licorice		60.33	52.22	54.89	48.33	53.94
L.S.D. 0.05		5.574				*N. S.*
	Tea compost × Heavy Elements					***Tea compost***
Non		62.11	53.67	55.78	47.56	54.78
1/5		64.11	56.56	53.78	48.22	55.67
1/10		59.44	54.00	53.56	47.00	53.50
L.S.D. 0.05		5.574				*N. S.*
Heavy Elements		61.89	54.37	54.37	47.59	
L.S.D. 0.05		3.218				

According to the results of the table, the binary interaction caused a significant difference in the mentioned characteristic, and the interaction of spraying with natural extracts and tea compost achieved a significant response. The treatment of licorice extract interacting with the 1/5 ratio recorded the highest average of 56.50 leaves, while the treatment of licorice extract interacting with the 1/10 ratio recorded the lowest average of 51.58 leaves. As for the interaction between spraying plant extracts and stress treatments, the control treatment achieved the highest average of 64.11 leaves, while the interaction of spraying malt natural extracts and stress treatments with lead and copper recorded the lowest average of 46.67 leaves.

The results of the table also showed that there were significant differences caused by the interaction of adding tea compost to the pots of plants stressed with heavy elements, while the treatment of interaction the ratio of 1/5 for non-stressed carnation plants recorded a significant superiority of 64.11 leaves, compared to the interaction of the ratio of 1/10 for plants stressed with the two elements, which recorded the lowest. Average of 47.00 leaves. The triple interaction of the study factors had a significant increase in the number of leaves, as the triple interaction treatment (spraying non-stressed plants with water only and the 1/5 treatment) recorded the highest average of 66.67 leaves, thus surpassing most of the triple interaction treatments, while the triple interaction treatment (spraying carnation plants with licorice extract and adding tea compost in a ratio of 1/10 stressed with a mixture of the two elements) the lowest average was 44.00 leaves.

3.3. Number of vegetative branches (plant branch^{-1}):

Referring to Table 3, significant differences were found for the licorice extract with the highest average being 8.64 branch, while the lowest average was recorded for the control treatment, 6.81 branch. Tea compost did not have a significant effect in the same trait. Abiotic stress also had a significant effect, as the control treatment achieved the highest average number of vegetative branches, reaching 9.52 branch, thus significantly outperforming all other treatments, while the mixture treatment recorded the lowest average, 6.19 branches. Interaction the spraying of natural extracts with the addition of tea compost achieved a significant response in the number of vegetative branches. The interaction spraying with licorice extract in the 1/10 ratio resulted in the highest average of 9.08 vegetative branches, while the two treatments of interaction spraying with water and malt extract in the 1/10 ratio recorded the lowest average of 9.08 branches. 6.67 branches. As for the interaction of plant extracts and stress treatments, the interaction and spray interaction treatment of licorice extract of unstressed carnation plants produced a significant increase in the number of vegetative branches, with the highest average amounting to 10.33 branches, in contrast to the treatment of not spraying plants with the natural extract and plants stressed with lead and copper, which gave the lowest average of 5.22 branches.

The results of the table also showed that there were significant differences caused by the interaction of adding tea compost to pots of plants stressed with heavy elements, as the 1/5 ratio treatment for non-stressed plants recorded the highest average of 10.44 branches, while the treatment of not adding the mixture to carnation plants stressed with both elements recorded the lowest average of 6.00 branch. The triple interaction of the study factors caused a significant effect on the number of branches. Treating plants by spraying with malt extract and adding tea compost at a ratio of 1/5 that were not stressed with heavy elements recorded the highest average of 11.33 branches, while the lowest average was recorded when carnation plants were not treated with natural extract and at a ratio of 1/10 that were stressed. With both components, the lowest average for this trait reached 4.33 branch.

Table 3. Effect of natural extract and tea compost and their interaction on the number of vegetative branches of carnation plants stressed by heavy elements

Extract	*Tea compost*	*Heavy Elements*				*Extract × Heavy Elements*
		Non	*Cu*	*Pb*	*Pb + Cu*	
Non	*Non*	8.00	6.33	7.00	5.67	6.75
	1/5	8.67	7.00	6.67	5.67	7.00
	1/10	8.00	7.67	6.67	4.33	6.67
Malt	*Non*	10.67	8.33	7.33	6.00	8.00
	1/5	11.33	8.00	6.33	6.00	7.92
	1/10	8.00	6.33	6.33	6.00	6.76
Licorice	*Non*	9.00	7.67	8.33	6.67	7.92
	1/5	11.33	8.67	8.33	7.33	8.92
	1/10	10.67	8.67	8.67	8.33	9.80
L.S.D. 0.05			2.616			1.308
		Extract × Heavy Elements				*Extract*
Non		8.22	7.00	6.78	5.22	6.81
Malt		10.00	7.56	6.67	5.89	7.53
Licorice		10.33	8.33	8.44	7.44	8.64
L.S.D. 0.05			1.510			0.755

Tea compost × Heavy Elements					Tea compost
Non	9.22	7.44	7.56	6.00	7.56
1/5	10.44	7.89	7.11	6.33	7.94
1/10	8.89	7.56	7.22	6.22	7.47
L.S.D. 0.05		1.510			*N. S.*
Heavy Elements	9.52	7.64	7.30	6.19	
L.S.D. 0.05		0.872			

3.4. Dry weight of the shoot (gm):

The results of Table 4 showed that there were significant differences in this trait caused by spraying carnation plants with natural extracts, as the spraying treatment with licorice recorded the highest average of 10.634 gm, outperforming the other treatments, while plants not sprayed with the extract recorded the lowest average of 9.700 gm. Treating plants with tea compost gave significant results at the 1/5 ratio, with the highest average of 10.431gm. Thus, it was significantly superior to the rest of the treatments, in contrast to the control plants, which achieved the lowest average of 10.035gm. The heavy elements which caused a significant reduction when both elements were present in the agricultural soil, with an average of 9.287 gm, on the other hand, the control treatment gave the highest average of 11.126 gm and thus it was significantly superior. It was observed that there were significant differences due to the interaction of the natural extract and tea compost, as the ratio of 1/5 without spraying with the extract achieved the highest average amounting to 10.804 gm in contrast the lowest average was recorded when the control treatment was treated with an average amounting to 9.155 gm.

Table 4. Effect of natural extract and tea compost and their interaction on the dry weight of shoots of carnation plants stressed with heavy elements (gm)

Extract	*Tea compost*	*Heavy Elements*				*Extract × Heavy Elements*
		Non	*Cu*	*Pb*	*Pb + Cu*	
Non	***Non***	10.645	9.060	9.728	7.184	9.155
	1/5	11.035	9.942	10.225	9.537	10.184
	1/10	10.654	8.706	10.328	9.359	9.762
Malt	***Non***	10.588	10.295	9.947	9.760	10.148
	1/5	11.631	10.849	10.313	8.952	10.436
	1/10	11.351	10.063	9.751	9.084	10.062
Licorice	***Non***	11.816	10.920	9.808	9.671	10.804
	1/5	11.602	10.625	10.300	10.163	10.672
	1/10	10.813	10.673	10.340	9.877	10.426
L.S.D. 0.05			0.6483			0.3242
	Extract × Heavy Elements					*Extract*
Non		10.778	9.236	10.094	8.693	9.700
Malt		11.190	10.402	10.004	9.266	10.215
Licorice		11.410	11.073	10.149	9.904	10.634
L.S.D. 0.05			0.3743			0.1872
	Tea compost × Heavy Elements					*Tea compost*
Non		11.016	10.425	9.828	8.872	10.035
1/5		11.423	10.472	10.279	9.551	10.431

1/10	10.940	9.814	10.140	9.440	10.083
L.S.D. 0.05		0.3743			0.1872
Heavy Elements	11.126	10.237	10.082	9.287	
L.S.D. 0.05		0.2161			

The significant effect continued with the effect of the binary interaction, with the interaction treatment (spraying carnation plants with licorice extract not stressed with heavy elements) achieving the highest average of 10.410 gm, while the treatment of not spraying plants with natural extracts stressed with both elements had a significant effect in reducing the average of this trait to 8.872 gm. Significant differences were also found in the effect of the interaction between tea compost and abiotic stress with heavy elements when treating the non-stressed 1/5 ratio interaction, which recorded the highest average amounting to 11.423 gm. In contrast, the lowest average was achieved when the double interaction treatment (no spraying with the natural extract and stress with the mixture of heavy elements), which It reached 8.872 gm. The results of the same table showed that the triple interaction between the study factors had a significant effect on the same trait, as the interaction treatment (spraying unstressed plants with licorice extract without adding tea compost) recorded the highest average of 11.816 gm, thus surpassing most of the triple interaction treatments, while the lowest average interaction treatment (not spraying plants stressed with copper and lead, using natural extract, and adding tea compost) averaged 7.184 gm.

3.5. Leaves' total chlorophyll content (SPAD):

The statistical analysis data presented in Table 5 indicate that there are significant differences in the chlorophyll trait of carnation plants due to the effect of treating the plants with different types of natural extracts sprayed on the shoots. The spraying treatment with licorice extract was significantly superior to the control treatment only by achieving the highest average for this trait, which reached 38.98 SPAD, while a significant difference was recorded from the malt treatment with an average of 37.92, while the lowest average was recorded in the control treatment, which amounted to 36.68 SPAD. As for the effect of tea compost, the results of the same table showed that there were significant differences in this trait resulting from treating plants with different ratios of the organic-bio mixture, as the 1/5 ratio treatment had a significant effect on the other treatments by recording the highest average of 38.53 SPAD compared to the treatment. The control achieved the lowest average of 37.16 SPAD. The results indicated that abiotic stress represented by heavy elements had a significant effect on the trait itself. The control treatment achieved the highest average for the chlorophyll trait, amounting to 39.72 SPAD, thus significantly outperforming the other treatments, while the mixture treatment with the heavy elements lead and copper recorded the lowest average for this trait, amounting to 36.14 SPAD.

According to the results presented in the same table, the binary interactions between the experimental factors caused a significant difference in the chlorophyll character of the carnation plant, while the interaction treatment of spraying with licorice extract and the ratio of 1/5 for the plants recorded the highest average of 38.81 SPAD, while the lowest average was achieved in the control treatment. With an average of 35.58 SPAD. As for the interaction between spraying plant extracts and stress treatments, the interaction treatment of spraying with licorice extract for non-stressed plants produced the highest average of 40.87 SPAD, while the interaction treatment of not spraying extracts for plants stressed with a mixture of lead and copper elements recorded the lowest average of 34.99 SPAD. The results of the same table showed that there were significant differences caused by the interaction of adding tea compost to the pots of plants stressed by heavy elements, as the interaction treatment of 5/1 for plants not stressed by heavy elements recorded the highest average for clove plants, amounting to 41.00 SPAD, while the interaction treatment of not adding the organic-bio mixture to the plants recorded. The lowest average for those stressed with lead and copper was 35.96 SPAD. The interaction of the three study factors had a significant effect on this trait, as treatment of carnation plants sprayed with licorice extract and the ratio of 1/5 for plants not stressed with heavy elements recorded the highest average of 42.00 SPAD, while the interaction treatment recorded for plants stressed with a mixture of heavy elements lead and copper, not treated with natural extracts. The lowest average for tea compost was 33.50 SPAD.

Table 5. Effect of natural extract and tea compost and their interaction on the chlorophyll content of leaves of carnation plants stressed by heavy elements (SPAD)

Extract	*Tea compost*	*Heavy Elements*				*Extract × Heavy Elements*
		Non	*Cu*	*Pb*	*Pb + Cu*	
Non	***Non***	38.20	36.63	34.00	33.50	35.58
	1/5	39.20	39.03	36.83	36.57	38.02
	1/10	38.77	35.60	36.50	34.90	36.44
Malt	***Non***	38.47	38.67	37.80	37.20	38.03
	1/5	41.37	39.20	38.36	35.87	38.77
	1/10	38.43	36.07	36.63	36.77	36.98
Licorice	***Non***	38.70	37.77	37.77	37.17	37.85
	1/5	42.00	38.40	39.00	35.83	38.81
	1/10	41.90	40.53	41.23	37.47	40.28
L.S.D. 0.05			3.412			1.706
	Extract × Heavy Elements					*Extract*
Non		38.87	37.09	35.78	34.99	36.68
Malt		39.42	37.98	37.69	36.61	37.92
Licorice		40.87	38.90	39.33	36.82	38.98
L.S.D. 0.05			1.970			0.985
	Tea compost × Heavy Elements					*Tea compost*
Non		38.46	37.69	36.52	35.96	37.16
1/5		41.00	38.88	38.16	36.09	38.53
1/10		39.70	37.40	38.12	36.38	37.90
L.S.D. 0.05			1.970			0.985
Heavy Elements		39.72	37.99	37.60	36.14	
L.S.D. 0.05			1.137			

4. Discussion

The difference in values for the studied traits shown in Tables 1-5 may be due to the significant effect caused by the study factors, including tea compost, which works to chelate most of the nutrients, especially the minor elements that work to stimulate the enzymes necessary for the formation of gibberellins and auxins, which then become centers of attraction. Nutrients that stimulate cambium cell division and increase their size [7]. This is reflected positively in most growth characteristics, such as the number of leaves, plant height, and number of branches [8], in addition to the concentration of N.P.K. elements within the organic matter, which is reflected positively in improving the properties of the soil, providing elements and raising its readiness for absorption by plants which positively affects various vital activities such as elongation and division of meristematic cells and the construction of proteins in addition to the formation of nucleic acids [9], and containing the substance organic matter contains a high percentage of major elements, such as nitrogen, which is primarily involved in building the chlorophyll molecule, in addition to its role in cell division and elongation, and this is directly reflected in an increase in the percentage of dry matter and the chlorophyll content of the leaves, as in Table 5 [10].

Organic matter also plays a major and effective role in increasing the activity of microorganisms, which in turn works to prepare the soil and plants with some necessary enzymes, including Protease and Phosphatase, which work to improve plant growth and increase root activity to absorb nutrients from the soil. It also works to form carbonic acid resulting from its decomposition, as it reduces the pH value of the soil and thus increases its microelements [29]. In addition to the role of organic matter in helping the root system grow by improving the chemical and physical properties of the soil, increasing the readiness of the necessary nutrients, and providing a suitable environment [11]. As a result, Hassanein [30] explained that the organic matter provides the agricultural medium with the nitrogen necessary for the metabolism of hormones and proteins, as it is primarily involved in their synthesis. It also works to raise the plant's content of amino acids, which is reflected positively in increased growth and diagonal division of root cells, which increases the accumulation of the substance.

Dry inside the plant as in Table 4. The reason for the significant superiority in terms of treatment with natural plant extracts, especially when spraying with licorice root extract, may also be due to the extract containing Glycyrrhizin acid, which has an effective role in cell division and elongation, thus increasing the average root properties, which in turn is reflected in increased absorption rates, thus increasing the accumulation of Nutrients inside the plant, as well as containing the mevalonic, which behaves similar to gibberellin [12].

The reason for the superiority may be that the extract contains many nutritional elements that contribute to increasing vegetative growth, and it also contains sugars and stimulating compounds that regulate vegetative growth, the extract also affects enzymes for converting complex compounds into simpler compounds that the plant exploits in building new protein materials, necessary for its growth, and the plant cells may be able to absorb part of the extract's sugars and benefit from them in their vital activities, thus increasing the vegetative characteristics such as the height of the plant, the number of branches, and the number of vegetative branches, thus increasing its dry weight. As for the significant increase occurring in the chlorophyll content of the leaves due to the effect of the licorice extract, it may be due to the reason is that the extract contains terpene compounds, carbohydrates, and nutritional elements, the most important of which is Mg, which has a major role in building the chlorophyll molecule [18].

The results of the tables above show a significant reduction and decline in the values of the studied traits as a result of treatment with heavy elements. This may be due to the negative effect of these elements, as these elements increase the production of harmful (ROS) compounds for the plant, and to reduce their damage, the plant produces defensive secondary metabolic compounds that play an important role in protecting it from its dangers. It is also clear from the results that the interaction of the two factors of the study (extracts and tea compost) had a synergistic effect in increasing growth and this significant increase may be explained by the role of the plant in modifying the osmotic property of cells in a way that is proportional to the increase in the negative potential of the cell exposed to stress and its ability to survive. In conditions of soil contaminated with heavy elements due to the ability of its roots to withdraw and absorb these elements from the soil without causing significant damage to the construction and metabolic processes carried out by the plant [19], [20].

5. Conclusion

In this study concluded that the study factors had a significant effect on the studied vegetative growth characteristics. The triple interaction treatment (licorice extract and 5/1 ratio of tea compost for non-stressed plants) had a significant superiority in plant height, number of leaves, number of vegetative branches, and chlorophyll content of leaves with an average of (23.67cm, 64.33 leaves, 11.33 branches, and 42.00 SPAD).

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