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Article

# The role of adding potassium humate and foliar spraying with marine algae on the mineral content and nutritional value of Moringa

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**ABSTRACT**
An experiment was carried out in the plastic house at the Agricultural Research Station in Bani Maqam, affiliated to Jam Jamal Agriculture Directorate in Sulaymaniyah Governorate, in a randomized complete block design, with three replications, on June 10, 2021. Furthermore, 4, 8, 12 and 16 kg hectares when planting and before the first irrigation and after each mowing process, and the second factor was spraying with seaweed extract Alga000 at three levels 0, 1, and 2 ml (2 and 4 ml per liter of total spray) and at two intervals after 20 and 30 days of planting After 10 and 25 days of mowing, at a height of 20 cm from the surface of the ground, the mineral content of leaves and dry stems samples of the first mowing plants was estimated. It included the content of calcium, iron and manganese (mg/100g dry matter) and the percentage of nitrogen, phosphorous and potassium. Indicators of the nutritional value of the leaves and stems of the first mow, which included the estimation of the percentage of total carbohydrates, ash, protein and fiber. The results showed that adding 16 kg hectares of potassium humate and spraying at a concentration of 2 ml per liter twice with algae extract Bahriya recorded the highest content of iron (42.3 and 19.82), calcium (2103.7 and 1009.29) and manganese (40 and 10.15) mg/100 g of dry matter for leaves and stems. The highest percentage of phosphorous was 0.333% in dry leaves, and the highest percentage of nitrogen (3.89%) and 1.58%), potassium (1.601% and 1.24%), protein (24.314% and 9.885%), total carbohydrates (35.23% and 11.86%), and the lowest fiber content (4.57% and 25.45%) in the dry matter. For leaves and stems.
**Keywords:** moringa, potassium humate, marine algae, mineral content, nutritional value

## INTRODUCTION

Moringa oleifera L. is an important crop grown for various uses. Moringa is native to India but has been cultivated worldwide for its biomass, mineral content and high nutritional quality. Its cultivation has spread rapidly over the past decade for multifaceted consumption, including what is included in medicines, nutrition as nutritional supplements or fodder for livestock and poultry, and other industrial applications, including water purification. It has great characteristics and capabil-

ities to become one of the most important crops economically in tropical and semi-tropical regions, especially In intensive agriculture [1]. It was used to reduce micronutrient malnutrition among the citizens of many African countries through feeding on its papers. Area unit.

The importance of improving the organic matter in agricultural soils is due to its effects on soil properties and plant growth, as the loss of organic matter in the soil and its low percentage is evident in most agricultural soils. Minerals and humic materials can be used by adding them to the soil or spraying them directly on plants in low concentrations to enhance plant growth, yield and nutrient absorption, as they contain a common class of plant biostimulants ([2], as well as seaweed extracts, which contain a group of elements Multiple micro-, plant growth hormones have a positive role in enhancing the vegetative and reproductive growth indicators of plants according to the phytonutrients available in the soil including nitrogen, potassium and phosphorous, since cytokines, including potassium, Sodium, calcium, magnesium, zinc, and iodine reinforce many trace elements essential for vegetation growth. Many researchers have found positive results of the aqueous macroalgae extract on various agricultural plants, including grain and forage crops. Because seaweeds live in coastal shallow aquatic environments with high salt concentrations on the ocean shores, the biological molecules that were synthesized with high concentrations that can alter the osmotic pressure of plants and foliar spraying of algae extract was another affordable and environmentally friendly solution to increase potential and achieve higher levels of productivity. Growth stimulants include auxins or cytokines, so interest in it seemed to be a sustainable solution not only to improve crop yield but also to improve soil fertility. [2] Adding it to improve vegetative growth and increase the yield because it provides plants with the nutrients they require in building health organic compounds and improves the course of vital activities within the plant, and therefore this makes it an alternative to synthetic competitive agrochemicals [3]

Because of the economic importance of the moringa plant in several areas and the scarcity of studies on it in Iraq, if not the first study in which it is grown as a forage crop to obtain biomass in intensive cultivation and determine its nutritional value.

## MATERIALS AND METHODS

The experiment was conducted in the plastic house at Al-Houth Agricultural Station in Bani Maqam in the Jam Jamal area after preparing the land by plowing it with a triple-disc plow and then a good smoothing and leveling procedure to prepare a suitable cradle for cultivation in the agricultural season 2021 according to the design of random sectors with three replications, and raised basins with a height of 20 were prepared. Cm, width of 2 m, and length of 45 m for each sector, with an interval between one sector and another of 1.5 m, which included 4 lines of drip lines with a distance of 0.4 m between one area and another 0.2 m (Jaison, 2016), all experimental units were fertilized with the compound fertilizer 20: 20: 20 of nitrogen, phosphorous and potassium at a rate of 240 kg hectares before planting and placed near the drip lines at a depth of 5 cm and was uniformly applied to all experimental units. Between one line and another 0.4 m (the area of the experimental unit is 2.4 x 1.6 m2), the moringa seeds were planted after soaking for 24 hours in water by two seeds in his hole (near the area) on 6/10/2021. The study factors included: The first solution is the ground addition of potassium humate at five levels: 1- Addition of potassium humate, 2- Addition of 4 kg ha, 3- Addition of 8 kg ha, 4- Addition of 12 kg ha, 5- Addition of 16 kg ha, and it was added when planting and before the first irrigation, and after each mowing process, The second factor is seaweed extract with three levels for spraying on the shoots: 1- Spraying with water only 2- Spraying with the extract at a concentration of 1 ml per liter of water 3- Spraying with the extract 2 ml per

liter of water. Moreover, 25 after each mowing, the first mowing of moringa plants was done 60 days from sowing the seeds, the whole biomass of the plant was harvested above the ground at the height of 20 cm from the ground level, and the subsequent harvest was done each time after 45 days at the same level as the first harvest.

The mineral content and nutritional value in the dry leaves and stems of moringa were estimated in the plant samples (which were collected, dried and milled) from the leaves and stems of each of them individually and from the first mow plants only, where the vegetable powder was digested by acid digestion or wet washing according to [4] and the standard curve of the elements was prepared according to the method of [5]) and was calculated according to

Iron content mg/100g = (sample absorption/sample weight) x 100, which was suggested by [6]

The manganese content (mg/100gm) of dry matter was estimated using [7] methods, followed by calibration according to the standard curve.

The percentage of nitrogen (%) was estimated based on the method mentioned by [8], and the percentage of phosphorous (%) was estimated based on the method presented by the scientist (Chapman and Pratt, 1961), and the percentage of potassium in the digested samples of leaves was estimated. And dry stems according to the method of [8]

The nutritional value indicators of the leaves and stems of Moringa plants were estimated as total carbohydrates by Hedge and Hofreiter, 1962. The percentage of ash was estimated according to [9]

Ash percentage (%) = weight of the jar with the sample after burning - weight of the empty jar/weight of the sample x 100

The Keldahl method was also used to estimate the protein percentage in the models, based on the method mentioned by [8] according to the following equation.

Protein % = volume of HCl consumed standard x 0.014 x 6.25/ sample weight x 100

The crude fibers were also estimated according to the method of [6] according to the equation Percentage of crude fibers = (sample weight ÷ dry sample weight) x 100

## RESULTS

*Iron content mg 100 g dry matter for leaves and stems*

Table (1) showed a significant effect of humic addition on iron concentration in Moringa leaves, as it was noticed that it increased with increasing levels of addition. The concentration of iron when there was no addition was 35.3 mg 100 gm. In contrast, in the dry matter of the stems, the concentration of iron in it decreased compared to the leaves to less than half of its concentration, which was the lowest concentration when the no addition was treated. It reached 13.481 mg 100 gm. Its concentration increased to 19,086 mg 100 gm when The level of addition was 16 kg hectares, which led to an increase in iron concentration, compared to the treatment of no addition, 17.3 and 41.6 in the dry matter of leaves and stems, respectively, and this could be due to the effect of humic on the content of chlorophyll in leaves, which is positively reflected in an increase in the efficiency of photosynthesis, which leads To increase the iron content, and humic materials are mainly containing iron.

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| The effect of adding humic | legs | | | The effect of adding humic | leaves | | | Humic levels in kg ha |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water. | | | | Marine algae spray levels in ml/liter of water. | | | |
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 13.481$^{e}$ | 13.880$^{jk}$ | 13.450$^{k}$ | 13.115$^{k}$ | 35.300$^{d}$ | 36.000$^{gh}$ | 35.400$^{hi}$ | 34.500$^{i}$ | **0** |
| 14.580$^{d}$ | 15.190$^{hi}$ | 14.460$^{ij}$ | 14.090$^{jk}$ | 38.383$^{c}$ | 39.600$^{cde}$ | 38.350$^{ef}$ | 37.200$^{fg}$ | **4** |
| 16.230$^{c}$ | 16.810$^{ef}$ | 16.390$^{fg}$ | 15.490$^{gh}$ | 39.550$^{b}$ | 40.750$^{bc}$ | 39.500$^{cde}$ | 38.400$^{ef}$ | **8** |
| 17.555$^{b}$ | 18.710$^{bc}$ | 17.640$^{de}$ | 16.315$^{fg}$ | 40.733$^{a}$ | 41.800$^{ab}$ | 41.000$^{ab}$ | 39.400$^{de}$ | **12** |
| 19.086$^{a}$ | 19.840$^{a}$ | 19.340$^{ab}$ | 18.080$^{cd}$ | 41.400$^{a}$ | 42.300$^{a}$ | 41.400$^{ab}$ | 40.500$^{bcd}$ | **16** |
| | 16.886$^{a}$ | 16.256$^{b}$ | 15.418$^{c}$ | Algae spray effect | 40.09$^{a}$ | 39.130$^{b}$ | 38.000$^{c}$ | **Algae spray effect** |

**Table 1. Effect of adding humic and spraying marine algae on the iron content of mg.100 g of dry leaves and stems of Morinca in the first mowing**

A significant increase in iron content was observed in the effect of spraying with algae extract. Its highest concentration in leaves was 40.9 mg 100 gm when sprayed with a concentration of 4 ml L seaweed. The iron content increase was 5.5% compared to spraying with water, which recorded the lowest iron content of 38.0 mg 100 gm. In the dry matter of the stems, the concentration of spraying 4 ml liter also recorded the highest iron content of 16,886 mg 100 g, with an increase of 9.5% compared to spraying with water, which recorded the lowest iron content of 15.418 100 g.

The interaction of the levels of humic addition and spraying with algae extract significantly affected the content of leaves and stems. The highest content and significant difference at the application level of 16 kg hectares and spraying with a concentration of 4 ml l amounted to 42.3 and 19.84 mg 100 g dry matter from leaves and stems, respectively.

*Calcium content mg 100 g dry matter leaves and stems:*

Table (2) shows the effect of adding humic and spraying with algae extract on the concentration of calcium mg 100 gm of dry matter for leaves and stems. It is noted that the levels of addition led to a significant increase in calcium content, as the lowest content in the no-addition treatment reached 1587.13 and 849.55 mg. In contrast, the highest content was recorded at The level of addition of 16 kg ha amounting to 2036.18 and 993.89 mg of 100 gm of dry matter, and the percentage of increase in calcium content was 28.3 and 17.0% in both leaves and stems, respectively.

| The effect of adding humic | legs | | | The effect of adding humic | leaves | | | Humic levels in kg ha |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water. | | | | Marine algae spray levels in ml/liter of water. | | | |
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 849.5$^{e}$ | 880.3$^{h}$ | 842.5$^{i}$ | 825.8$^{i}$ | 1587.1$^{d}$ | 1673.2$^{ijk}$ | 1580.2$^{jk}$ | 1508.0$^{k}$ | **0** |
| 908.6$^{d}$ | 929.8$^{fg}$ | 911.7$^{g}$ | 884.4$^{h}$ | 1731.5$^{c}$ | 1815.5$^{fg}$ | 1740.0$^{ghi}$ | 1639.1$^{ij}$ | **4** |
| 943.0$^{c}$ | 963.2$^{de}$ | 950.3$^{ef}$ | 915.6$^{g}$ | 1854.8$^{b}$ | 1956.1$^{b-e}$ | 1837.6$^{egf}$ | 1770.8$^{gh}$ | **8** |
| 968.4$^{b}$ | 989.2$^{abc}$ | 977.6$^{bcd}$ | 938.4$^{f}$ | 1917.7$^{b}$ | 1978.5$^{bc}$ | 1919.5$^{c-f}$ | 1855.1$^{d-g}$ | **12** |
| 993.8$^{a}$ | 1009.2$^{a}$ | 998.9$^{ab}$ | 973.4$^{cd}$ | 2036.2$^{a}$ | 2103.7$^{a}$ | 2043.2$^{ab}$ | 1961.6$^{bcd}$ | **16** |
| | 954.3$^{a}$ | 936.2$^{b}$ | 907.5$^{c}$ | Algae spray effect | 1905.4$^{a}$ | 1824.1$^{b}$ | 1746.9$^{c}$ | **Algae spray effect** |

**Table 2. Effect of adding humic and spraying with marine algae on the content of calcium mg.100 g of dry leaves and stems of Morinca in the first mowing**

This may be due to an increase in the absorbed amount of calcium. The reason for the increase in the calcium content of leaves and stems may be that the humic added to the soil increases the soil's ability to retain water and raises the cationic capacity, which increases the availability and absorption of calcium from the plant [9] Moringa plants may tend to absorb this element and accumulate it in plant tissues. It is noted that the calcium content in each of the leaves and stems of the moringa plant was recorded as the lowest content when spraying with water, amounting to 1746.92 and 907.529 mg 100 g. In contrast, the highest content when spraying with 4 ml liter of algae extract amounted to 1905.4 and 954.368 mg 100 g and the percentage of increase was 9.1 and 5.2% in the dry matter weight of leaves and stems, respectively. It is noted that the percentages of increase by the effect of spraying with algae were less than it was due to the effect of adding humic. This can be explained by the fact that the nitrogen and calcium content in free algae that are added as a spray to the vegetative system contribute to an effective and important role in the photosynthesis process, which results in the accumulation of carbohydrates in the leaves, in addition to humic and algae materials, which are carbon compounds that build plant tissues [10]

From the interaction of levels of humic addition and spraying with algae extract, it was found that the addition of 16 kg hectares and the spraying at a concentration of 4 ml liter reached 2103.7 and 1009.29 mg 100 g dry matter weight of leaves and stems, respectively. At the same time, the control treatment gave the lowest calcium content in them.

*Manganese content mg 100 g dry matter leaves and stems:*

Table (3) shows the effect of adding humic substances and spraying with marine algae on the manganese content in the dried leaves and stems of Morinca. A significant effect of the addition of humic in the leaves is noted, as the addition treatments 16 and 12 hectares kg hectare recorded the highest manganese content in the leaves, which amounted to 39,417 and 38.450 mg/ha, with a non-significant difference, with the addition of 8 kg ha of humic. However, it differed significantly from the treatments of 0 and 4 kg ha of humic. In the stems, the treatment of adding 16 kg hectares of humic was superior to the highest manganese content of 9.98 mg 100 gm, and the concentration of manganese increased with the increase in the levels of humic addition, which was the lowest in the manganese content when the non-addition treatment reached 6.41 mg 100 gm of dry matter weight of the stems.

| **The effect of adding humic** | **legs** Marine algae spray levels in ml/liter of water. 4 | 2 | 0 | **The effect of adding humic** | **leaves** Marine algae spray levels in ml/liter of water. 4 | 2 | 0 | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| 6.413$^{e}$ | 7.280$^{j}$ | 6.195$^{k}$ | 5.765$^{l}$ | 35.533$^{bc}$ | 36.100$^{a-d}$ | 35.500$^{bcd}$ | 35.00$^{cd}$ | **0** |
| 8.138$^{d}$ | 8.825$^{gh}$ | 8.290$^{i}$ | 7.300$^{j}$ | 34.667$^{c}$ | 32.500$^{d}$ | 36.200$^{a-d}$ | 35.300$^{cd}$ | **4** |
| 8.998$^{c}$ | 9.280$^{de}$ | 9.110$^{ef}$ | 8.605$^{h}$ | 37.650$^{ab}$ | 38.500$^{abc}$ | 37.850$^{abc}$ | 36.600$^{a-d}$ | **8** |
| 9.435$^{b}$ | 9.910$^{ab}$ | 9.510$^{cd}$ | 8.885$^{fg}$ | 38.450$^{a}$ | 39.300$^{abc}$ | 38.700$^{abc}$ | 37.350$^{abc}$ | **12** |
| 9.983$^{a}$ | 10.150$^{a}$ | 10.070$^{a}$ | 9.730$^{bc}$ | 39.417$^{a}$ | 40.000$^{a}$ | 39.700$^{ab}$ | 38.550$^{abc}$ | **16** |
| | 9.089$^{a}$ | 8.635$^{b}$ | 8.057$^{c}$ | Algae spray effect | 37.590$^{a}$ | 37.280$^{a}$ | 36.560$^{a}$ | **Algae spray effect** |

**Table 3. Effect of adding humic and spraying with marine algae on the content of manganese mg.100gm of dry leaves and stems of Morinca in the first mowing.**

The effect of spraying with algae extract showed significant differences in the content of manganese mg 100 g of dry matter, as the leaves had the highest concentration of it at the 2 and 4 ml spray treatments, which amounted to 37.28 and 37.59 mg 100 g, which was a significant difference compared to spraying with water, which recorded the lowest concentration of 36.56 mg 100 g, as for the weight of the dry matter of the moringa stems in the first mowing, it differed significantly, and the concentration of manganese increased with increasing the concentration of spraying with the extract. It was higher when spraying with a concentration of 4 ml liter that reached 9.089 mg 100 gm, while the lowest concentration recorded when spraying with water was 8.057 mg 100 gm of dry matter.

The interaction of levels of humic addition and concentrations of algae extract spray had a significant effect on the differences between the average concentration of manganese, and its highest content was recorded when adding 16 kg hectares of humic and spraying with a concentration of 4 ml liter of algae was 40 and 10.15 mg 100 gm of dry matter for leaves and stems, respectively. Dry moringa of manganese can be of special importance in adding moringa and its inclusion in the diet of animals and humans.

*The percentage of phosphorous in the dry matter of leaves and stems:*

Table (4) shows the effect of adding humic and spraying with algae on the percentage of phosphorous in Morinca leaves and stems. The levels of addition, which gave the lowest percentage of phosphorous when not added, amounted to 0.222%. The percentage increase between them amounted to 41.9%. The levels of spraying algae extract had a significant effect on the percentage of phosphorus in the leaves, as it was noted that the increase in the spraying concentration increased the percentage of phosphorus. The highest percentage was recorded when spraying with a concentration of 4 ml liter, which amounted to 0.286 %, with an increase of 13.5% compared to spraying with water, which had the lowest phosphorous percentage and amounted to 0.252.%

The interaction of levels of humic addition and spraying with the extract showed significant differences in the proportions of phosphorus for the combination of the two workers, and the highest percentage was 0.333% when adding 16 kg ha and spraying with a concentration of 4 ml L of seaweed. In contrast, the effect of adding humic and spraying algae extract was not significant in the percentage of phosphorus in the dry matter. It was increased for the stems of the moringa plant but did not reach the limits of statistical significance.

| **The effect of adding humic** | **legs** | | | **The effect of adding humic** | **leaves** | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water. | | | | Marine algae spray levels in ml/liter of water. | | | |
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 0.059[a] | 0.063a | 0.060a | 0.054a | 0.222[e] | 0.237[g] | 0.225[h] | 0.2050[i] | **0** |
| 0.065[a] | 0.073a | 0.065a | 0.057a | 0.248[d] | 0.260[f] | 0.250[f] | 0.236[gh] | **4** |
| 0.073[a] | 0.080a | 0.073a | 0.066a | 0.273[c] | 0.289[cd] | 0.281[de] | 0.250[f] | **8** |
| 0.079[a] | 0.088a | 0.080a | 0.070a | 0.294[b] | 0.313[b] | 0.299[c] | 0.272[e] | **12** |
| 0.074[a] | 0.059[a] | 0.089a | 0.074a | 0.315[a] | 0.333[a] | 0.313[b] | 0.299[c] | **16** |
| | 0.073[a] | 0.073[a] | 0.064[a] | Algae spray effect | 0.286[a] | 0.273[b] | 0.252[c] | **Algae spray effect** |

**Table 4. Effect of adding humic and spraying with marine algae on the percentage of phosphorous in the dry leaves and stems of Morinca in the first mowing**

The reason for this may be due to the addition of humic substances to the soil, which may contribute to lowering the soil pH and increasing the readiness of the phosphorous element for the plant, and this was supported by [11], which returned the reason for the increase in phosphorous absorbed by the plant to the addition of humic, as he considered it a rich source With nutrients, including phosphorous, and the nutrients in the algae extract added by spraying on the leaves are transferred to the cells of the leaves of the plant easily, which facilitates their access and facilitate, including phosphorus, which paves the way for the continuation of interactions leading to better plant growth.

*The percentage of nitrogen in the dry matter of leaves and stems:*

Table (5) which shows the effect of adding humic and spraying algae extract on the percentage of nitrogen in the dry matter of leaves and stems in the first mowing, as it appears from it that the percentage of nitrogen was significant by the effect of adding humic, and the highest percentage of nitrogen in the dry leaves was when adding 12 and 16 kg humic It reached 3.395 and 3.508 with a significant difference from the other levels of addition, and the percentage increase in them was 42.5 and 47.2%, respectively, compared to the non-addition, which gave the lowest percentage of nitrogen amounted to 2.383%. In contrast, in the dry stems, the addition level exceeded 16 kg per hectare humid with the highest percentage of nitrogen amounting to 1.526 %. There was a significant difference from the rest of the addition levels, and the percentage increase was 26.3% compared to the treatment of no addition, as the lowest percentage of nitrogen was recorded, amounting to 1.208%.

The spraying with marine algae had a significant effect on the nitrogen content in the dry leaves and stems of the first mowing, as the spraying with a concentration of 4 ml liter of algae gave the highest percentage of 3.307 and 1.438 %, and the percentage increase in them was 21.2 and 9.4% compared to spraying with water as an average of humic addition levels, which It gave the lowest nitrogen content of 2.712 and 1.315 % in dry leaves and stems, respectively.

| **The effect of adding humic** | **legs** | | | **The effect of adding humic** | **leaves** | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water. | | | | Marine algae spray levels in ml/liter of water. | | | |
| | 3 | 2 | 1 | | 3 | 2 | 1 | |
| 1.208$^{d}$ | 1.260$^{gh}$ | 1.215$^{hi}$ | 1.150$^{i}$ | 2.383$^{d}$ | 2.610$^{gh}$ | 2.330$^{hi}$ | 2.210$^{i}$ | **1** |
| 1.333$^{c}$ | 1.380$^{de}$ | 1.335$^{efg}$ | 1.285$^{fgh}$ | 2.706$^{c}$ | 2.910$^{ef}$ | 2.780$^{fg}$ | 2.430$^{hi}$ | **2** |
| 1.396$^{b}$ | 1.440$^{cd}$ | 1.400$^{cde}$ | 1.350$^{ef}$ | 3.075$^{b}$ | 3.320$^{cd}$ | 3.100$^{de}$ | 2.805$^{fg}$ | **3** |
| 1.428$^{b}$ | 1.530$^{ab}$ | 1.435$^{cd}$ | 1.320$^{efg}$ | 3.395$^{a}$ | 3.805$^{ab}$ | 3.380$^{cd}$ | 3.000$^{ef}$ | **4** |
| 1.526$^{a}$ | 1.580$^{a}$ | 1.530$^{ab}$ | 1.470$^{bc}$ | 3.508$^{a}$ | 3.890$^{a}$ | 3.520$^{bc}$ | 3.115$^{de}$ | **5** |
| | 1.438$^{a}$ | 1.383$^{b}$ | 1.315$^{c}$ | Algae spray effect | 3.307$^{a}$ | 3.022$^{b}$ | 2.712$^{c}$ | **Algae spray effect** |

**Table 5. Effect of adding humic and spraying with marine algae on the percentage of nitrogen in the dry leaves and stems of Morinca in the first mowing**

The interaction between the levels of humic addition and spraying with concentrations of algae showed a significant effect on the nitrogen ratios for the interaction combinations, as the highest percentage of nitrogen reached 3.89 and 1.58% when adding 16 kg hectares of humic and spraying with concentration of 4 ml of algae in the dry leaves and stems of Moringa plant.

*The percentage of potassium in the leaves and stems of Morinca:*

It is clear from Table (6) the effect of adding humic and spraying with marine algae on the percentage of potassium in the leaves and stems of the moringa plant. Adding 12 and 16 kg hectares of humic reached 1.531 and 1.546 %, while the lowest percentage was 1.384 and 0.845 % in the dry matter of leaves and stems, respectively.

The effect of spraying with marine algae was significant, as the highest potassium percentage when spraying with a concentration of 4 ml liter was 1.512 and 1.102 %. The percentage of increase was 5.2 and 22.7% compared to spraying with water, which gave the lowest percentage of potassium, amounting to 1.438 and 0.898 % in the dry matter For leaves and stems.

Potassium has a role in regulating the work of stomata, as its presence in the guard cells affects the osmotic pressure inside the plant and thus serves as the driving force for opening and closing stomata, both of which may contribute to encouraging vital processes leading to increased plant growth, which helps in increasing the contents of nutrients, including potassium Which has an effective role in regulating the work of enzymes of physiological reactions [12]

| The effect of adding humic | legs | | | | leaves | | | Humic levels in kg ha |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water | | | The effect of adding humic | Marine algae spray levels in ml/liter of water | | | |
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| $0.845^{d}$ | $0.940^{efg}$ | $0.850^{gh}$ | $0.745^{i}$ | $1.384^{d}$ | $1.405^{fg}$ | $1.382^{gh}$ | $1.367^{h}$ | **0** |
| $0.933^{c}$ | $1.000^{def}$ | $0.970^{def}$ | $0.830^{hi}$ | $1.438^{c}$ | $1.467^{cde}$ | $1.439^{ef}$ | $1.410^{fg}$ | **4** |
| $1.033^{b}$ | $1.130^{bc}$ | $1.060^{cd}$ | $0.910^{fgh}$ | $1.485^{b}$ | $1.528^{b}$ | $1.480^{cd}$ | $1.44^{de}$ | **8** |
| $1.126^{a}$ | $1.200^{ab}$ | $1.200^{ab}$ | $0.980^{def}$ | $1.531^{a}$ | $1.561^{b}$ | $1.549^{b}$ | $1.485^{c}$ | **12** |
| $1.155^{a}$ | $1.240^{a}$ | $1.200^{ab}$ | $1.025^{de}$ | $1.546^{a}$ | $1.601^{a}$ | $1.552^{b}$ | $1.485^{c}$ | **16** |
| | $1.102^{a}$ | $1.056^{b}$ | $0.898^{c}$ | Algae spray effect | $1.512^{a}$ | $1.480^{b}$ | $1.438^{c}$ | **Algae spray effect** |

**Table 6. Effect of adding humic and spraying with marine algae on the percentage of potassium in the dry leaves and stems of Morinca in the first mowing**

*Percentage of protein in the dry matter of leaves and stems:*

The results in Table (7) show the significant effect of the levels of humic addition on the percentage of protein in the dry matter of leaves and stems, as it was found that the addition of 12 and 16 kg hectares of humic recorded the highest percentage of protein in the leaves, reaching 21.22 and 21.93%, respectively, with a significant difference compared to the other levels. The lowest percentage of protein was recorded when it was not added, which amounted to 14.898, with an increase of 29.79 and 47.3%, respectively. At the same time, in the stems, the level of 16 kg per hectare recorded the highest percentage of protein, amounting to 9.545%, with a significant difference compared to other levels of addition, in which the lack of humic recorded the lowest percentage of protein 7.553 % and an increase of 26.4%, which is a reflection of the effect of adding humic on the nitrogen percentage of the leaves and stems of the dry matter of the Moringa plant.

It is also noted that the effect of spraying with concentrations of algae extract was significant in the percentage of protein, which is noted to increase with increasing concentration of spray, and the highest percentage of protein when spraying with a concentration of 4 ml liter was 20.672 and 8.991%, with an increase of 21.9 and

9.4% compared to spraying with water, which was recorded The lowest protein content was 16,952 and 8.991% in the dry matter of leaves and stems, respectively. From the interaction of levels of humic addition and spraying with marine algae, it is noted that the percentage of protein differed significantly, as the treatment of adding 16 kg of humic hectares and spraying with a concentration of 4 ml liter recorded the highest protein percentage of 24,314 and 9.88% in the dry matter of leaves and stems, respectively, with an insignificant difference at the level of addition 12 kg ha and at the same spray concentration.

| **The effect of adding humic** | **legs** Marine algae spray levels in ml/liter of water. | | | **The effect of adding humic** | **leaves** Marine algae spray levels in ml/liter of water. | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 7.553$^{d}$ | 7.875$^{gh}$ | 7.595$^{hi}$ | 7.190$^{i}$ | 14.898$^{d}$ | 16.315$^{gh}$ | 14.565$^{hi}$ | 13.815$^{i}$ | **0** |
| 8.335$^{c}$ | 8.630$^{de}$ | 8.345$^{efg}$ | 8.030$^{fgh}$ | 16.918$^{c}$ | 18.190$^{ef}$ | 17.375$^{fg}$ | 15.190$^{hi}$ | **4** |
| 8.733$^{b}$ | 9.005$^{cd}$ | 8.755$^{cde}$ | 8.440$^{ef}$ | 19.221$^{b}$ | 20.755$^{cd}$ | 19.375$^{de}$ | 17.535$^{fg}$ | **8** |
| 8.930$^{b}$ | 9.565$^{ab}$ | 8.970$^{cd}$ | 8.255$^{efg}$ | 21.220$^{a}$ | 23.785$^{ab}$ | 21.125$^{cd}$ | 18.750$^{ef}$ | **12** |
| 9.545$^{a}$ | 9.880$^{a}$ | 9.565$^{ab}$ | 9.190$^{bc}$ | 21.930$^{a}$ | 24.315$^{a}$ | 22.005$^{bc}$ | 19.470$^{de}$ | **165** |
| | 8.991$^{a}$ | 8.646$^{b}$ | 8.221$^{c}$ | Algae spray effect | 20.672$^{a}$ | 18.88$^{b}$ | 16.952$^{c}$ | **Algae spray effect** |

**Table 7. Effect of adding humic and spraying with marine algae on the percentage of protein in the dry leaves and stems of Morinca in the first mowing.**

***Percentage of total carbohydrates in leaves and stems:***

It is evident from Table (8) that the percentage of carbohydrates in the dry matter of the leaves differed significantly with the effect of adding humic. The highest percentage of carbohydrates was recorded at the 16 kg hectare application level, which amounted to 36.637%, with an insignificant difference compared to the additional 12 kg hectares. In contrast, the lowest percentage of carbohydrates was recorded. 32.73% upon non-add transaction

| **The effect of adding humic** | **legs** Marine algae spray levels in ml/liter of water. | | | **The effect of adding humic** | **leaves** Marine algae spray levels in ml/liter of water. | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 11.051$^{e}$ | 11.115$^{fg}$ | 11.075$^{g}$ | 10.965$^{g}$ | 32.730$^{b}$ | 32.500$^{b}$ | 32.810$^{b}$ | 32.880$^{b}$ | **0** |
| 11.246$^{d}$ | 11.350$^{ed}$ | 11.260$^{ef}$ | 11.130$^{fg}$ | 33.848$^{b}$ | 34.760$^{b}$ | 33.950$^{b}$ | 32.835$^{b}$ | **4** |
| 11.423$^{c}$ | 11.520$^{bc}$ | 11.480$^{cd}$ | 11.270$^{ef}$ | 33.532$^{b}$ | 34.655$^{b}$ | 33.330$^{b}$ | 32.610$^{b}$ | **8** |
| 11.570$^{b}$ | 11.640$^{bc}$ | 11.580$^{bc}$ | 11.490$^{bcd}$ | 34.563$^{ab}$ | 34.980$^{b}$ | 34.440$^{b}$ | 34.270$^{b}$ | **12** |
| 11.691a | 11.860$^{a}$ | 11.655$^{b}$ | 11.560$^{bc}$ | 36.637$^{a}$ | 35.230$^{ab}$ | 35.430$^{ab}$ | 39.250$^{a}$ | **16** |
| | 11.497$^{a}$ | 11.410$^{b}$ | 11.283$^{c}$ | Algae spray effect | 34.425$^{a}$ | 33.992$^{a}$ | 34.369$^{a}$ | **Algae spray effect** |

**Table 8. Effect of adding humic and spraying with marine algae on the percentage of carbohydrates in the dry leaves and stems of Morinca in the first mowing**

The percentage increase was 11.94%, while it was in the dry matter of the stems, which also differed significantly, in which the addition level of 16 kg per hectare

recorded the highest percentage of carbohydrates, amounting to 11.691%, while the lowest percentage recorded when not adding was 1.051.%

It is noted that the levels of marine algae spraying in which the spraying with a concentration of 4 ml liter recorded the highest percentage of carbohydrates, which amounted to 34.425 and 11.497% in the dry matter of leaves and stems, respectively, but it did not reach the statistical significance in the dry matter of leaves. At the same time, there was a significant difference in the dry matter of the stems, which was recorded in it. Treatment of spraying with water was the lowest rate of 11.283%.

It was found that the differences in the percentage of carbohydrates to match the levels of humic addition and seaweed spraying were that the level of adding 16 kg hectares and spraying at a concentration of 4 ml liter recorded the highest percentage of carbohydrates, amounting to 35.23 and 11.860% in the dry matter of leaves and stems, respectively.

*Percentage of ash in the dry matter of leaves and stems:*

Table (9) shows the effect of adding humic leach with seaweed extract on the percentage of ash in the dry matter of leaves. It stemmed from the Moringa plant in the first mowing, as the effect of adding 16 kg hectares of humic significantly exceeded the highest percentage.

| **The effect of adding humic** | **legs** | | | **The effect of adding humic** | **Leaves** | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | Marine algae spray levels in ml/liter of water. | | | | Marine algae spray levels in ml/liter of water. | | | |
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 12.090$^{c}$ | 12.060$^{f}$ | 12.110$^{ef}$ | 12.100$^{ef}$ | 10.216$^{c}$ | 10.130$^{ef}$ | 9.970$^{f}$ | 10.550$^{b-e}$ | **0** |
| 12.395$^{b}$ | 12.600$^{ab}$ | 12.355$^{b-e}$ | 12.230$^{def}$ | 10.300$^{c}$ | 10.400$^{c-f}$ | 10.310$^{def}$ | 10.190$^{ef}$ | **4** |
| 12.420$^{b}$ | 12.550$^{abc}$ | 12.510$^{abc}$ | 12.200$^{ef}$ | 10.476$^{bc}$ | 10.550$^{b-e}$ | 10.500$^{b-e}$ | 10.380$^{c-f}$ | **8** |
| 12.496$^{ab}$ | 12.600$^{ab}$ | 12.570$^{abc}$ | 12.320$^{c-f}$ | 10.643$^{b}$ | 10.810$^{abc}$ | 10.670$^{bcd}$ | 10.450$^{b-e}$ | **12** |
| 12.576$^{a}$ | 12.600$^{ab}$ | 12.650$^{a}$ | 12.480$^{a-d}$ | 10.963$^{a}$ | 11.160$^{a}$ | 10.920$^{ab}$ | 10.810$^{abc}$ | **16** |
| | 12.482$^{a}$ | 12.439$^{a}$ | 12.266$^{b}$ | Algae spray effect | 10.610$^{a}$ | 10.474$^{a}$ | 10.476$^{a}$ | **Algae spray effect** |

**Table 9. The effect of adding humic and spraying with marine algae on the percentage of ash in the dry leaves and stems of Morinca in the first mowing**

Ash in the dry leaves and stems amounted to 10.963 and 12.576%, but it was in the stems with a non-significant difference with the additional 12 kg hectares. This is a reflection of the accumulation of dry matter, as it is noted that the percentages of ash in the dry matter of the stems are higher than those in the leaves.

The effect of spraying with marine algae showed that spraying with a concentration of 2 and 4 ml per liter recorded the highest percentage of ash in the dry matter of the stems, which amounted to 12.439 and 12.482%, with a significant difference from spraying with water, which recorded the lowest ash percentage of 12.266%. In contrast, the effect of spraying with seaweed was insignificant in the percentages of ash in the dry matter of the leaves.

The combination of the levels of humic addition and marine algae spraying differed significantly in the ash ratios, as the highest ash percentage was recorded when adding 16 kg hectares of humic and spraying with a concentration of 4 ml liter algae in the dry matter of the leaves amounted to 11.160% with an insignificant difference from spraying with other concentrations of algae extract at the same level of addition from humic, and also compared to the level of addition of 12 kg hectares of humic when spraying at a concentration of 4 ml l algae. In the dry

matter of the stems, the addition of 16 kg hectares and spraying with a concentration of 2 ml per liter of algae showed the highest ash percentage of 12.650% and a non-significant difference with several combinations, including all levels of humic addition when spraying at a concentration of 4 ml per liter of algae except for not adding humic, as well as all levels of humic addition When spraying at a concentration of 2 ml per liter except for the addition level of 0 and 4 kg ha humic, it differed significantly in the match of the levels of humic addition and spraying with water except for the level of adding 16 kg ha humic.

*The percentage of fiber in the dry matter of leaves and stems:*

Table (10) shows the percentages of fiber in the dry matter of the leaves and stems of the Moringa plant by adding humic and larch with seaweed. The lowest percentage of fibers was recorded when adding 16 kg hectares, amounting to 4,820 and 26,523% in the dry matter of leaves and stems, respectively. Ash ratios for the same combinations.

Spraying with marine algae showed a significant decrease when spraying with higher concentrations of seaweed. When spraying with water, the highest percentages of fibers were 5.850 and 30.084%. They decreased significantly, as the lowest percentage of fibers when spraying with 4 ml liter of algae was 5.358 and 28.442% in the dry matter of leaves. The legs are straight. The interaction of the levels of adding humic and spraying with seaweed had a significant effect on the percentages of fibers, as the lowest percentage of fibers was 4.570 and 25.450% when adding 16 kg of humic and spraying at a concentration of 4 ml liter of algae. In comparison, the highest percentage of fibers when not adding humic and spraying with water was 6.420 and 31.830%.

| **The effect of adding humic** | **legs** Marine algae spray levels in ml/liter of water. | | | **The effect of adding humic** | **leaves** Marine algae spray levels in ml/liter of water. | | | **Humic levels in kg ha** |
|---|---|---|---|---|---|---|---|---|
| | 4 | 2 | 0 | | 4 | 2 | 0 | |
| 31.693$^{a}$ | 31.810$^{a}$ | 31.440$^{ab}$ | 31.830$^{a}$ | 6.256$^{a}$ | 6.070$^{bc}$ | 6.280$^{ab}$ | 6.420$^{a}$ | **0** |
| 30.423$^{b}$ | 29.340$^{cd}$ | 30.320$^{bc}$ | 31.610$^{a}$ | 5.956$^{b}$ | 5.850$^{cd}$ | 5.930$^{c}$ | 6.090$^{bc}$ | **4** |
| 28.99$^{c}$ | 28.180$^{def}$ | 28.660$^{def}$ | 30.150$^{c}$ | 5.670$^{c}$ | 5.380$^{e}$ | 5.660$^{d}$ | 5.970$^{c}$ | **8** |
| 28.150$^{d}$ | 27.430$^{fg}$ | 27.890$^{ef}$ | 29.130$^{cde}$ | 5.260$^{d}$ | 4.920$^{gh}$ | 5.210$^{ef}$ | 5.650$^{d}$ | **12** |
| 26.523$^{e}$ | 25.450i | 26.420$^{gh}$ | 27.700$^{f}$ | 4.820$^{e}$ | 4.570$^{i}$ | 4.770$^{hi}$ | 5.120$^{fg}$ | **16** |
| | 28.442$^{b}$ | 28.946$^{b}$ | 30.084$^{a}$ | Algae spray effect | 5.358$^{c}$ | 5.570$^{b}$ | 5.850$^{a}$ | **Algae spray effect** |

**Table 10. Effect of adding humic and spraying marine algae on the percentage of fibers in the dry leaves and stems of Morinca in the first mowing**

## DISCUSSION

Among the results of the mineral content and nutritional value in the dry matter of the leaves and stems, which were previously mentioned in Tables (1), it appears that the moringa plant is a rich source of important minerals, including calcium, potassium, zinc, iron, copper, manganese and ascorbic acid, so it can be used in improving the diet of farm animals and humans. The maximum protein content (18.54%) was recorded when seedlings were provided with a 100% dose of the recommended fertilizer along with Pseudomonas fluorescent and humic acid [13] Nitrogen uptake and metabolism, which may lead to increased protein content [14] Humic acid contains indole-3-acetic acid (auxin) [15] which affects the IAA on sucrose metabolizing activity,

Ponnuswarni and Rani (2019) found that the addition of humic substances led to an increase in the availability and absorption of the required nutrients and the improvement of the soil environment and the readiness of the elements, which contributes to the synthesis of chlorophyll, and it obtained an increase in the percentage of fibers and the highest content of iron and this was attributed to the improvement in the synthesis of chlorophyll and enzymes Catalase, peroxidase and cytochrome oxidase, which contribute to an increase in iron content, and humic substances play a role in increasing the content of major and microelements in plant organs, as they have a great potential to increase performance and growth, which is reflected in the mineral content of the plant, and contribute to an increase in calcium content. Morinca was considered a good source of calcium for farm animals and humans, and adding humic at a level of 20 kg hectares of humic gave the highest content of manganese and zinc, whose presence in large quantities is particularly important in the nutritional aspect. Moringa are important indicators of increasing the importance of the plant as an important source of nutrition, and [16] stated that humic substances led to an increase in The percentage of nitrogen and phosphorous in the dry matter of the leaves, and [17] mentioned that the organic fertilizer recorded an increase in the percentage of nitrogen, protein, phosphorous, potassium and magnesium, and the highest content of iron and a percentage of carbohydrates. However, it did not affect the content of zinc.

The reason for promoting plant growth is by providing substances called auximones by humic acid, and they contain many microelements, such as Cu, Zn, Mo, B, Co and growth-promoting substances such as cytokinin, which results from the use of humic additives and spraying with algae extract to increase The chlorophyll content of leaves, which is a key factor in determining the rate of photosynthesis, is an indicator of the metabolic efficiency of plants which is responsible for harnessing solar energy and converting it into chemical energy, and is sufficient to cause changes in the physiological processes of plants, particularly photosynthesis [18] The effect of the total chlorophyll content of Morinca leaves by the foliar application of biostimulants and the increase in biomass of them may be a result of being a source of minerals and micronutrients (Jayashree, 2006) which may be a source of nitrogen, magnesium and iron for the formation of chlorophyll structure in chloroplasts, which leads to a high content of total chlorophyll, which It may contribute to the increased dry matter content of these elements, another possible reason may be that humic acid stimulated photosynthetic organelles such as bulbs. Green citrates can help in a high photosynthetic activity that helps in increasing the dry matter content of macro and micronutrients. Humic substances and seaweed extract contain macronutrients, microelements, organic matter such as amino acids, and plant growth regulators such as auxin cytokinin. Gibberellins, which may be responsible for the marked bio-stimulatory role, especially cytokines, as the application of biostimulants had a significant effect on the crude protein content, but its role in the case of the crude fiber content of moringa leaves [19]

The use of seaweed extract in crops has achieved many beneficial effects in terms of improving quality. Liquid extracts of seaweed have recently gained importance as a foliar spray for many crops as seaweed extracts contain major and secondary nutrients and amino acids, which are said to stimulate the growth and productivity of plants. The ability to withstand environmental stress was developed [20], and the effect of algae on leaves and stems included the total content of macro- and micro-nutrients in Moringa plants, as the foliar use of seaweed (extracted from seaweed) at high rates significantly increased the content of nitrogen and phosphorus. And potassium in high percentages and differed according to the dry matter of leaves and stems. The results also showed that spraying at high levels led to a noticeable increase in both iron and manganese and differed according to the cutting stages and that spraying algae at high rates had a positive effect on the protein

content [21] Seaweed extract has the potential to develop tolerance to environmental stress [22].

## CONCLUSIONS

This research concludes by studying the effect of adding different levels of humic and spray With levels of marine algae extract and its interactions in the nutritional value indicators (carbohydrates, protein and fiber) and its mineral content in order to determine the best combination that meets the desire of the product and recommend it.

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