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Effect Of Adding Humic Acid And Seaweed Extract On Some Vegetative And Chemical Traits Of The Peppermint Plant (Mentha Pipreta L.)

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Abstract

A factorial experiment was carried out according to the Randomized Complete Block Design (R.C.B.D) in the field and with three replicates during the agriculture season 2020/2021, at the Agricultural Research Station of the College of Agriculture, University of Basrah, in sandy clay soils, to study the effect of three levels of ground fertilization with humic acid in three concentrations (0, 1 and 2) ml. L^{-1}, and spraying with seaweed extract (Acadian) in three concentrations (0, 1 and 2) ml. L^{-1}, on the growth indicators of peppermint plant. The results showed a significant superiority of the treatment with humic acid at a concentration of 2 ml L^{-1} on the plant height (21.78 cm), leaves number (65.5 leaves. $plant^{-1}$), branches number (14.03 branches. $plant^{-1}$), chlorophyll content (10.09 mg.100g), the fresh weight (1.724 mg. g), dry weight (1.936 %) and potassium (1.246%). As for the extract of seaweed (Acadian), the concentration of 2 ml L^{-1} showed a significant superiority on the plant height (23.00 cm), leaves number (67.000 leaves. $plant^{-1}$), branches number (17.66 branches. $plant^{-1}$), chlorophyll content (10.11mg. 100g), the fresh (1.495 mg. g), dry weight (1.893 %) and potassium (1.231%). As for the interaction between humic acid and the extract of seaweed (Acadian), the combination (2 ml. L^{-1} humic acid × 2 ml. L^{-1} seaweed) showed significant superiority in all the traits under study.

Keywords: humic acid, seaweed extract, vegetative, chemical traits, peppermint (Mentha pipreta L.)

Introduction

Peppermint is one of the most important perennial aromatic plants, peppermint grows wild in different parts of the world, there are different types of it grown for commercial production, including the peppermint (Mentha pipreta), which belongs to the lamiaceae family, it is one of the large families, comprising about 200 genera and 6000 species of the genus Mentha (Dorman et al., 2003). The mint plant was described and named by the scientist Jussieu in 1789, within the family Lamiaceae, it includes nearly 200 genera and 3200 species distributed all over the world, most of them are aromatic plants with the presence of rosmarinic acid, its plants generally contain flowers with low petals similar to a prominent shape, it is a small, perennial or annual plant, there are about 11 hybrids, which is divided into four groups according to the chromosomal number and some common genetic traits (Ahmad et al., 2020).

Peppermint is classified as a hybrid between Menthe spicata and Mentha aquatic (Lawrence, 1992; Bhat et al., 2002). The peppermint plant is also grown in all types of lands and is highly resistant to salinity and alkalinity (Al-Shahat, 1986). The spraying of organic fertilizers and seaweed extracts is one of the techniques, its use has spread as a vital stimulator for the physiological functions of plants, contains stimulants and plant hormones important for growth, leads to increased growth through absorption of nutrients and resistance to freezing and diseases reflected positively in production and improving its quality (Daoud et al., 2013). And organic fertilization improves vegetative growth (Said Al-Ahl et al., 2009).

Seaweed has gained its importance as a foliar nutrient because its extracts contain micro-nutrients and growth-stimulating hormones, such as auxins, cytokinins, vitamins, gibberellins and amino acids (Featonby-Smith and Van staden, 1987). The improvement of vegetative growth in leafy crops, it is done in several ways, the most important of which is the use of organic fertilizers, including the use of humic acid, which is one of the important economic commercial products with rapid effectiveness and harmless to humans and animals. Humic acid improves soil fertility, increases the readiness of nutrients and thus increases plant growth, reduces the negative impact of salt stress (Eslah, 2010).

Pourhadi et al.(2018) stated that the treatment of mint plant by foliar spray with humic acid at a concentration of (400, 800) mg L^{-1}, led to improved vegetative growth and plant height, as well as improving the rates of fresh and dry weight of the plant at a concentration of 800 mg L^{-1}. Al-Barmaei (2007) observed that the addition of humic acid to broccoli plants at a level of 20 ml. L^{-1}, caused a significant superiority on the vegetative growth represented by height plant (8.1 cm), leaf area (276.30 cm) and dry weight (101.20 g).

The current study aims to demonstrate the effect of using each of humic acid and seaweed extract on some vegetative and chemical growth characteristics of peppermint plant (Mentha pipreta L.).

Materials Methods

A field experiment was carried out for the growing season 2020/2021 for the peppermint plant (Mentha pipreta L.), at the Agricultural Research Station of the College of Agriculture, University of Basrah, to study the effect of humic acid in three concentrations (0, 1 and 2) ml. L^{-1}, and seaweed extract (Acadian) in three concentrations (0, 1 and 2) ml. L^{-1}, on the growth characteristics of the pepperment plant. Before starting the experiment, random samples were taken from the used soil, to conduct some physical and chemical analyzes that were conducted in the laboratories of the College of Agriculture at the University of Basrah.

Table(1):physical and chemical properties of soil use in research.

properties	Values
Texture of soil%	Sandy clay
Organic material (g/kg^{-1})	0,208
PH	7.11
Electrical conductivity (ds.m^{-1})	6.71

Total nitrogen %	23.4
Available phosphorus (mg.kg^{-1})	8.5
Available potassium (mg.kg^{-1})	16.63
Clay %	32.45
Silt %	12.85
Sandy %	42.23

Experiment design

A factorial experiment was carried out according to a Randomized Complete Block Design (RCBD) with three replications, the experiment included 27 experimental units, an average of 9 units for each replicate, ground fertilization was done by adding humic acid, it was added in three installments between each batch and the other two weeks. It was also sprayed with seaweed extract (Acadian), which is a purple colored powder. The spraying process was carried out using a 10 liter backpack sprayer in the early morning, until completely wet, with the addition of the diffuser concentration of 0.1 ml.L^{-1}, to reduce the surface tension of water molecules, increasing the opportunity to benefit from it (Al-Sahhaf, 1989). The first spray was carried out a month after planting, by three sprays between each spray and the other two weeks.

Studied traits:

Plant height (cm): The height of the plant was measured from the soil surface to the top of the plant by measuring tape.

Branches number of (branch. plant^{-1}): The number of main branches for each plant and before each mowing was calculated and their average was calculated.

Leaves number of (leaf. plant^{-1}): The total number of leaves per five plants in each experimental unit was calculated and its average was recorded.

Total chlorophyll concentration in leaves (mg. 100g of fresh weight): The chlorophyll content of leaves was estimated according to Goodwin's method (1976). As took 6 leaves from the fifth leaf after the developing top of each experimental unit, washed it with distilled water and took 0.2 g of the sample, it was placed in a glass vial and 10 ml of acetone was added to it at a concentration of 80%, put in the centrifuge for 5 minutes, separate the filtrate from the sediment using filter paper, it was read with a Spectrophotometer at wavelengths of 645 and 663 nm, the content of chlorophyll a, b was calculated according to the equation:

Total chlorophyll= $20.2 \times D_{(645)} + 8.02 \times D_{(663)}$

The leaves' content of macronutrients: According to the method mentioned by Cresser and Parsons (1979), the content of the leaves from the major elements was estimated according to the following steps:

1. Take 0.2 of the crushed dry sample for each experimental unit and put it in a tube C.

2. 5 ml of concentrated sulfuric acid was added to it and left for 24 hours (overnight).

3. Heat the digester until it reaches a temperature of 400°C.

4. The samples were placed in the apparatus for half an hour until boiling.

5. Add 3 ml of the acidic mixture (4% ml of concentrated perchloric acid + 96% ml of concentrated sulfuric acid), then heated until the solution became clear and the volume was completed to 50 ml with distilled water.

The percentage of nitrogen in the leaves (%): Total nitrogen in the digested samples was measured using a steam distillation apparatus (Microkjeldahl) based on the method of Page et al. (1982).

Percentage of phosphorous in the leaves (%): It was estimated using a spectrophotometer with a wavelength of 470 nm according to the method (Murphy and Riley, 1962).

The percentage of potassium in the leaves (%): It was estimated using a flame photometer type 73JEN WA 73 PEP according to the method of Page et al. (1982). The results are expressed according to a standard curve in which potassium chloride.

Results and discussion

1. Effect of humic acid and extract and the interaction between them on the vegetative growth characteristics of peppermint plant:

Table (2) shows the effect of humic acid and seaweed extract and the interaction between them on vegetative growth indicators, the treatment of irrigated with humic acid at a concentration of 2 ml L^{-1} was superior in the highest height of 21.78 cm compared to the comparison treatment, it gave a minimum height of 18.19 cm, the leaves number (65.5 leaves. $Plant^{-1}$), the comparison treatment was the lowest value (59.1 leaves. $Plant^{-1}$). The number of branches reached the highest value of 14.03 branch.$plant^{-1}$ compared to the lowest value of 10.22 branch.$plant^{-1}$ and the leaf area gave the highest value of 1219 cm^2 $plant^{-1}$ compared to the lowest value of 548 cm^2 $plant^{-1}$.

As for the extract of seaweed, it was significantly superior to the treatment of spraying with the extract at a concentration of 2 ml L^{-1}, on the plant height trait, it gave the highest plant height of 21.17 cm, compared with the comparison treatment, which gave the lowest value of 17.45 cm. Leaves number, the highest value was 63.4 leaves. $Plant^{-1}$, and the lowest value was 62.1 leaves. $Plant^{-1}$. The branches number had the highest value of 15.86 branch. $plant^{-1}$, compared to the lowest comparison, which was 8.41 branch. $plant^{-1}$. The leaf area has the highest value of 1164 cm^2 $plant^{-1}$ and the lowest value is 685cm^2 $plant^{-1}$.

As for the interaction between humic acid and seaweed extract, the concentration of 2 ml L^{-1} in each trait exceeded the height of the plant, the number of leaves, the number of branches, it gave the highest values of (23.00 cm, 67.00 leaf. $plant^{-1}$, 17.66 branch. $plant^{-1}$),

respectively, compared to the control treatment, which gave the lowest values of (17.46 cm, 56.6 leaves plant^{-1}, 7.22 branches plant^{-1}), respectively.

The increase in vegetative growth indicators is the result of the cumulative effect between humic acid and seaweed extract, it may be attributed to the role of humic acid in increasing the physiological activities of plants, its reflection in the increase in growth and the content of the plant's nutrients, increasing cytokinin and endogenous auxin, as it is a humic substance that nourishes plants (Anonymous, 2005). As for the increase resulting from the use of the extract in improving the growth of the peppermint plant, because it contains major elements necessary for the plant NPK, stimulates plant growth and development, through its effect, it activates physiological processes, like photosynthesis, which reflects positively on the characteristics of vegetative growth (Abd-motty et al., 2010).

Table(2) Effect of humic acid and extract and the interaction between them on the vegetative growth characteristics of peppermint plant.

Treatment	Plant height (cm)	Leaves number (leaf.plant^{-1})	Branches number (branch.plant^{-1})
A0	18.19	59.1	10.22
A1	19.58	63.6	12.33
A2	21.78	65.5	14.03
L.S.D 0.05	3.44	13.63	2.539
B0	17.45	62.1	8.41
B1	18.93	62.7	14.30
B2	21.17	63.4	15.86
L.S.D 0.05	3.44	13.63	2.539
A0 B0	17.46	56.6	7.22
A0B1	17.80	58.7	12.89
A0B2	19.67	62.0	14.33
A1B0	19.33	62.6	8.26
A1B1	18.22	63.7	12.81
A1B2	19.67	64.6	15.59
A2B0	21.06	64.4	9.76
A2B1	18.34	65.1	17.21
A2B2	23.00	67.0	17.66
L.S.D 0.05	5.72	23.61	4.398

2. Effect of humic acid and seaweed extract on some chemical properties of peppermint plant:

Table (3) shows the effect of humic acid and seaweed extract and the interaction between them on the chemical properties of peppermint, the treatment of irrigated with humic acid excelled in most of the chemical properties of the leaves, the concentration of 2 ml L^{-1} had a

significant effect on the amount of chlorophyll, the highest value reached (10.09 mg 100 g fresh weight), compared with the lowest value of the control treatment was (8.66 mg 100 g fresh weight). This increase may be attributed to the role of humic acid in increasing the efficiency of photosynthesis, thus, increasing the processed nutrients in the process of cell division, which positively affected and consequently increased chlorophyll (Abu Dhahi and Al-Younis, 1988).

The percentage of nitrogen, which gave the highest value, was 1.936%, compared with the lowest value of the comparison treatment (1.603%). It is attributed to humic acid, which leads to an increase in total nitrogen in the soil when treated with it (Idris, 2009).

Potassium gave the highest value (1.246%), compared with the lowest value of the comparison treatment (1.204%). It is attributed to the role of humic acid, which increases the readiness of major and minor elements, including potassium, by forming chelating elements with compounds of these elements, then he works on editing it and converting it into a form that can be absorbed by the plant (Altomare et al., 1999).

As for the seaweed extract, the spraying treatment with the extract at a concentration of 2 ml L^{-1} was superior in the chemical properties of the leaves, including the amount of chlorophyll, which reached the highest value (10.11 mg 100 g fresh weight), compared with the lowest value for the control treatment (9.11 mg 100 g fresh weight), this may be attributed to the extract's content of cytokinins, encourage physiological activities such as encouraging some photosynthetic enzymes and increasing total chlorophyll in plants (Thomas, 1996).

The percentage of nitrogen (1.893) and the lowest value (1.529) and potassium, the highest value (1.231) and the lowest value (1.150).

As for the interaction between humic acid and the extract, it had a significant effect on all the chemical and qualitative characteristics of the leaves, as the concentration of 2 ml L^{-1} exceeded the amount of chlorophyll. The highest value was (10.44 mg 100 g fresh weight) compared to the lowest value (9.39 mg 100 g fresh weight). Nitrogen percentage (2.203%) and the lowest value (1.633%). Potassium had the highest value (1.263%) and the lowest value (1.190%).

Table(3) Effect of humic acid and seaweed extract on some chemical properties of peppermint plant.

Treatment	chlorophyll	N%	P%	K%
A0	8.66	1.603	0.6206	1.204
A1	9.96	1.852	0.6322	1.226
A2	10.09	1.936	0.6367	1.246
L.S.D 0.05	0.762	0.3153	0.01548	
B0	9.11	1.529	0.6178	1.150
B1	9.83	1.869	0.6322	1.229
B2	10.11	1.893	0.6344	1.231

L.S.D 0.05	0.762	0.3153	0.01548	
A0 B0	9.39	1.633	0.6237	1.190
A0B1	9.73	1.783	0.6267	1.193
A0B2	9.86	1.973	0.6233	1.230
A1B0	9.88	1.703	0.6300	1.200
A1B1	9.97	1.923	0.6300	1.213
A1B2	10.02	1.930	0.6367	1.257
A2B0	9.88	1.910	0.6267	1.237
A2B1	9.96	1.923	0.6400	1.243
A2B2	10.44	2.203	0.6433	1.263
L.S.D 0.05	1.320	0.5460	0.02682	

Conclusions:

1. Treating peppermint plants with humic acid and seaweed extract improved vegetative growth indicators, increased nitrogen and potassium content in leaves, as well as increased chlorophyll.

2. Irrigation with humic acid at a concentration of 2 ml. L^{-1} and spraying with seaweed extract at a concentration of 2 ml. L^{-1} to increase most of the vegetative growth indicators.

Recommendations:

1. Using humic acid and seaweed extract in high concentrations of each in order to get the highest amount of foliar yield

2. Doing other studies on the effect of addition methods to find out which method is more responsive.

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