Middle East Journal of Agriculture Research
Volume: 12 | Issue: 04| Oct. – Dec. | 2023

EISSN: 2706-7955 ISSN: 2077-4605
DOI: 10.36632/mejar/2023.12.4.52
Journal homepage: www.curresweb.com
Pages: 782-822

Effect of foliar spray with algae extract, bio- nitrogenous fertilization and different levels of nitrogen sources on vegetative growth, green yield, quality, essential oil yield and its active substances content in celery plants (*Apium graveolens*)

Zaki, M. F.[1], S. A. Abo Sedera[2], T. M. Abd El-Razik[3] and Hayam A. A. Mahdy [4]

[1]Vegetable Res. Dept., National Research Centre, 33 El Buhouth St., 12622, Dokki, Giza, Egypt
[2]Agricultural Microbiology Dept., National Research Centre, 33 El Buhouth St., 12622, Dokki, Giza, Egypt.
[3]Medicinal and Aromatic Plants Res. Dept., National Research Centre, 33 El Buhouth St., 12622, Dokki, Giza, Egypt.
[4] Botany Dept., National Research Centre, 33 El Buhouth St., 12622, Dokki, Giza, Egypt

Received: 25 Oct. 2023 **Accepted:** 30 Nov. 2023 **Published:** 15 Dec. 2023

ABSTRACT

Two field experiments were conducted in newly reclaimed soil for two successive winter seasons during 2019/2020 and 2020/2021 at El-Nubaria, El-Beheira Governorate, Egypt, to study the effect of foliar spray with algae extract (without and with algae); nitrogen bio-fertilization treatments, i.e., without bio., Microbein and Nitrobein and different levels of organic and mineral nitrogen fertilizers, i.e. 100 % Mineral N fertilizer + 0 % Compost, 50 % Mineral N fertilizer + 50 % Compost and 0 % Mineral N fertilizer + 100 % Compost on growth, vegetative yield, quality characteristics, essential oil content and major components percentage of essential oil in celery plants. Data indicate that there are significant differences of foliar spray as algae extract, Nitrobein as a bio fertilizer and application of 50% Mineral N fertilizer + 50% Compost for all studied characters in the two seasons. Spraying celery plants with algae extract gave a significant increase in vegetative growth, i.e., plant length, main leaf number, side leaf numbers, head circulenes, fresh and dry weight of leaves, necks and total plant. Also, spraying celery plants with algae extract gave a highest value of vegetive leaf yield, i.e., leaves, necks and whole plant; essential oil content, i. e., % (V/W) and per plant (ml.) in leaves, necks and whole plants and essential oil yield (liter/ fed.) in leaves, necks and whole plants and N, P and K% in leaves of celery as well as major component's percentages of essential oil content, i.e., D-Limonene (%), Trans-β-Ocimene (%) and 3-Butylisobenzo- furan 1(3H)-one (%) during two seasons. On the other hand, without spray by algae extract which recorded a highest value of Carvacrol (%), β-Caryophyllene, β-Selinene (%), Sedanenolide (%) and Trans-Sedanenolide (%). Inoculation by bio-fertilizers caused the highest significant values of the above-mentioned characteristics of vegetative growth; essential oil content, i. e. % (V/W) and per plant (ml.) and essential oil yield (liter/ fed.) in leaves, necks and whole plants of and N, P and K% in leaves celery as well as its active substances content of celery plants compared with control (without bio.). Microbein as a bio-fertilizer treatment was recorded the highest values of the above-mentioned characteristics compared with Nitrobein treatment and without bio-fertilizer. All treatment which received organic manure gave a significant increase in most of above-mentioned characteristics. So, the highest values of vegetative growth characteristics; essential oil content and essential oil yield (liter/ fed.) in leaves, necks and whole plants and N, P and K% in leaves celery as well as its active substances content of celery were obtained by plants which received 50% mineral N fertilizer + 50% compost follow up treatment of 100 % compost compared with the rate of 100 % Mineral N fertilizer. The lowest values were obtained by those plants which did not receive organic manure (100 % Mineral N fertilizer). The rate of 100 % Compost led to a significant increase in the major component's percentage such as D-Limonene (%) in essential oil of celery plants compared to other nitrogen sources rates. Average rate of 50% Mineral N fertilizer + 50% Compost was superior in active substances content such as Carvacrol (%) and 3-Butylisobenzofuran-1(3H)-one (%) compared

Corresponding Author: Zaki, M. F., Vegetable Res. Dept., National Research Centre, 33 El Buhouth St., 12622, Dokki, Giza, Egypt. E-mail: el_shakry2005@yahoo.com

to other treatment. High rate of organic fertilizer gave the highest values of the major components percentages of essential oil content in leaves of celery plants, i.e., Trans-β-Ocimene (%), β-Caryophyllene (%), β-Selinene (%), Sedanolide (%) and trans-Sedanolide (%) during two seasons Spraying algae extract with inoculation of Microbein as a bio-fertilizer and application of the rate of 50% mineral N fertilizer + 50% compost recorded the highest values of vegetative growth characteristics; total fresh leaf yield; bundles quality; oil yield and mineral content N%, P% and K% as well as major's chemical composition of essential oils.

Keywords: Celery, climate change, nitrogen bio-fertilization, mineral and organic nitrogen fertilizers rates, algae extract, essential oil content, mineral content, green leaf yield and major's chemical composition of essential oils.

1. Introduction

Celery (*Apium graveolens* L.) is a perennial or annual plant with wide distributions and belongs to the family Apiaceae or Umbelliferae. All parts of this plant have been used for thousands of years in a number of direct agents as flavoring agents in food industries and household foods (Ambrose *et al*., 2016). The genus Apium contains about 20 species of the family Apiaceae, and its various varieties are found in Eurasia. It is mostly grown in coastal areas due to suitable environmental conditions. Celery is widely grown in temperate zones for important garden crop and as a common vegetable due to its bleached leaf stalks (Satyavati *et al*., 1976). Celery needs a high level of humidity and low temperature level. It is believed that maximum production is obtained in cold weather regions. The total global production of celery oil from seeds is estimated at 51 tons, while India produces only 25 tons among all, while the rest of the volumes are the United Kingdom, Egypt, and the United States of America components and China. It contains various parts of celery, fatty acids, volatile essential oils, vitamins and minerals elements such as potassium, magnesium and calcium, as well as chlorophyll, silica, beta-carotene, fibers, sodium and folic acid.

Celery contains fat contents and brings high-calorie ingredients. It is also known to be a rich source of vitamin C and various other minerals elements. Its seeds contain volatile oil, proteins, crude fibers, moisture, starch, ash, carbohydrates and fixed oil (Keller and Matile, 1989). The fatty acids present in the fixed oil contains, i.e., oleic acid, palmitic acid, linoleic acid, stearic acid, linoleic acid and petrosilinic acid (Destaillats and Angers, 2002). Celery plant is a source of mineral elements such as calcium, magnesium, potassium and is also high content of sodium. It consists of an essential oil of bronze, sesquiterpenes, limonene and a distinctive aroma. It is a rich source of folic acid, potassium, sodium, fibers, beta-carotene, magnesium, silica and chlorophyll (Ayesha Khalil *et al*., 2015).

This research was conducted to study the behavior of foliar spraying with algae extract on growth, vegetative yield, quality and essential oil content in celery plants. The application of seaweed extract to various crops was of great importance due to it containing high levels of organic matter, microelements, vitamins and fatty acids, and also being rich in growth regulators such as auxins, cytokinins and gibberellins (Crouch and Van Staden, 1994). The beneficial effects of seaweed extract application is the result of several components that may act synergistically at different concentrations, although the mode of action is still unknown (Fornes *et al*., 2002). However, the use of seaweed extracts increased the chlorophyll content (Whapham *et al*., 1993 and Thirumaran *et al*., 2009). Doaa *et al*., (2023) On celery, it was indicated that the best parameters for plant height, number of leaves, leaf area, plant fresh weight, plant dry matter, stem diameter, total chlorophyll content, yield, chemical content and qualitative characteristics of celery plants were obtained by spraying algae extract on celery at a rate of 20 ml/L during the two study seasons. Then treatment of algae extracts at a rate of 20 ml/L gave the highest levels of nitrogen and protein percentage. Shams and Nahla Morsy (2019) On broccoli, it was shown that spraying plants with algae extract led to a significant improvement in plant growth indicators such as number of leaves, leaf area, fresh weight of plants, improved yield characteristics, head quality, vitamin C and TSS compared to plants sprayed with distilled water. Beigzadeh *et al*., (2019) On white beans (*Phaseolus vulgaris* L.) an application of 150 g. ha^{-1} seaweed extract was observed combined with salicylic acid increased the relative water content of leaves in plants grown under water deficit stress. The maximum chlorophyll content (15.15 mg. g^{-1} FW) was observed at 150 g. ha^{-1} seaweed

extract was applied under conditions of no water deficit stress. Therefore, this work aims to evaluate the effect of algae extract on the growth, productivity and quality of celery plants.

Fertilization is one of the most important factors that limit plant productivity. Extensive use of expensive mineral fertilizers leads to environmental pollution problems. However, chemical fertilizers at very high rates for a long time have reduced the potential activity of microflora and the stability of soil organic matter (Hussien, 1995).

Recently, much emphasis has been placed on the potential of biofertilizers as a promising component for the integration of nutrient supply system in agriculture. The term biofertilizer represents everything from organic manures to plant extracts. "Biofertilizers" are those substances containing microorganisms that colonize the rhizosphere of the plant and increase the supply or availability of primary nutrients and/or growth stimulants to the target crop. There are many types of soil bacteria that colonize mainly in the root zone of plants. These bacteria are collectively known as plant growth-promoting rhizobacteria (PGPR). Some types of PGPR promote growth by acting as a biofertilizer (Zenab Ahmed, 2017).

Microorganisms mainly nitrogen fixer, phosphate solubilizer, and mycorrhizal are the main sources of biofertilizers. Microorganisms used in biofertilizers are bacteria of Bacillus, Pseudomonas, Lactobacillus, photosynthetic bacteria, nitrogen fixing bacteria, Trichoderma fungi and yeast. Biofertilizers have shown great potential as a renewable and environmentally friendly source of plant nutrients. Biofertilizers are ready to use and are used as a live formulation of beneficial microorganisms, and when amended to seed, root or soil, they mobilize the availability and benefit of microorganisms thus improving soil health. In general, biofertilizers are microbial preparations containing living cells of different microorganisms which have the ability to move plant nutrients in the soil from unusable form to usable form through biological process. Biofertilizers are used in the live formulation of beneficial microorganisms which when applied to seeds, roots or soil, mobilize the availability of nutrients especially through their biological activity and help build up lost microflora thus improving overall soil health (Ismail *et al*., 2014). Their mode of action differs and can be used alone or in combination. Moreover, biofertilization is an important factor used to produce products free of some mineral fertilizers that cause environmental pollution problems, and its high rates lead to a decrease in the potential activity of microflora and the movement of organic matter. Hence, the focus has been on biofertilization research as a safe alternative to specific chemical fertilizers. Biofertilizers play a vital role in increasing the number of microorganisms and accelerating a certain microbial process in the soil rhizosphere inoculating plants which can change the available forms of certain nutrients to plants. (Kandeel *et al*., 2001, Rashed, 2002; Mohamed and Abdu, 2004). The current research aims to study the effect of biofertilizers alone or in combination with NPK inorganic fertilizers on the growth and oil composition of celery plants. The goal was to reduce the use of non-organic fertilizers (NPK).

The undesirable effects of chemical fertilizers on human health and the environment can be reduced by using organic fertilizers (AbouEl-Hassan *et al*., 2017; Naeem *et al*., 2006), such as biofertilizers (organic fertilizers that contain beneficial soil microorganisms). It has various benefits, including stabilizing soil particles, enhancing soil fertility, and restoring nutrients. In addition, compost provides plant growth hormones such as gibberellins, auxins and cytokinins (Ravindran *et al*., 2015; Singh *et al*., 2020; Song *et al*., 2015). Composts can be considered an environmentally friendly alternative to mineral nutrition for plants. Compost increases the water holding capacity of the soil and the organic matter content of the soil (Mehta *et al*., 2014; Ning *et al*., 2017; Shen *et al*., 2013). Manure is used in preparing biofertilizers due to its physical and chemical properties. Composts provides macro- and micronutrients, antibiotics and substances that regulate plant growth-regulating substances (Kumar *et al*., 2017; Naveed *et al*., 2015). Adding organic fertilizers and low urea were the most effective treatments in reducing color changes, weight loss, titratable acidity (TA), pH, and total dissolved solids (TSS) of fresh-cut celery. Organic fertilizers enhanced the vitamin C content, total phenols, and antioxidant activity of celery (Mesbah *et al*., 2023).

2. Materials and Methods

This study was carried out on celery 'Giant Pascal' (*Apium graveolens* var. *dulce*) Fam. Apiaceae or Umbelliferae cv. Gian in an area of newly reclaimed land the experimental farm of National Research Center, at El-Nobaria, Beheria Governorate, Egypt, during the two successive winter seasons of

2019/2020 and 2020/2021.The aim of this work studying the effect of foliar spray with algae extract; nitrogen bio-fertilization treatments and different levels of nitrogen fertilizers sources on growth, vegetative yield, quality characteristics, chemical content and essential oil content and its active substances content in celery plants.

Random soil samples were collected before planting from the top layer (0-30 cm depth) for physical and chemical analysis. Soil analysis is presented in Table (1), Soil physical properties were analyzed using the procedures described by Black *et al.,* (1981) for particle size distribution and soil texture, while soil chemical analysis was measured according to the procedures described by Jackson (1973). On the other hand, organic manure (compost) contents of total and available N, P and K and available were presented in Table (2) and their analysis followed the procedures of Black *et al.,* (1981). The soil of the experiment was carefully prepared, in each growing season.

Table 1: The physical and chemical properties of the experimental soil during the two seasons of 2019/2020 and 2020/2021.

A. Physical properties: -			
Characters		**(2019/2020) season**	**(2020/2021) season**
Soil texture		Loamy sand	Loamy sand
Clay (%)		11.38	13.54
Silt (%)		0.66	1.25
Sand (%)		87.96	85.21
B. Chemical properties: -			
pH		8.40	8.37
E.C.(mmhos)		2.10	1.06
$Caco_3$ %		1.00	1.25
Cations	**Ca^{++}(Milliequivalent/L)**	23.00	22.00
	Mg^{+2}	12.00	11.00
	Na^{+1}	14.00	17.35
	K^{+1}	2.79	2.62
Anions	**Co_3^{-}**	-	-
	HCO_3^{-}	7.10	4.55
	Cl^{-1}	26.00	25.00
	$So_4^{=}$	18.69	23.42

Table 2: Chemical analysis of compost manure during two season of 2019/2020 and 2020/2021.

Mineral contents	**(2020/2021) season**	**(2019/2020) season**
N (%)	2.20	2.46
P (%)	0.91	1.80
K (%)	1.40	2.37
Fe ppm	2400	230
Mn ppm	342	266
Zn ppm	140	18
Cu ppm	97	36
Pb ppm	1.01	1.20
Cd ppm	1.10	0.90
Ni ppm	2.1	3.60
Co ppm	8.00	6.00
C/N	4.29	7.40
D.M (%)	28.1	46.5
O.C(%)	16.3	27.00
Humidity (%)	17.20	17.48

The soil of the experimental plots was carefully prepared, in each growing season. Ditches of 20 cm depth and 40 cm width were prepared in the sites of drip irrigation lines. Calcium super phosphate and organic manure (compost) were mixed according to each treatment and added in the ditches then covered by soil. Urea (46 % N) was used as a source of mineral nitrogen fertilizer at a rate of 100 kg/ fed., calcium super phosphate (15.5 % P_2O_5) as a source of phosphorus at a rate of 50 kg/ fed. and potassium sulphate (48 % K_2O) was used as a source of potassium at a rate of 50 kg/ fed. The quantities of the mineral fertilizer were splinted into two equal doses and applied as dressing (30 and 60 days after transplanting) beside plants. Most of the uptake is during the last four weeks prior to harvest.

Drip irrigation lines were spread over the ditches. Soil was irrigated continuously three days before transplanting. Seedlings were sown on the two sides of each row 75 cm in width and 50 cm apart. Each plot included three rows; plot area was 21.0 m^2. Seedlings were sown in the open field on 15 th of September in 2019/2020 and 2020/2021 seasons.

Samples of celery plants were collected from different treatments of celery. This experiment was carried out under field condition. The number of 18 plots (3mx7m) each comprised of four rows and 28 pits per holes per row, which were conducted in split – split plots design with three replicates.

Treatments of the experiment were as follows

A. Algae extract: Two treatments of algae extract, i.e., without and with algae. Spraying with algae extract at the age of 45 days and at a rate of two sprays at a concentration of 3 cm^3 / liter.

B. Nitrogen bio-fertilization: Three treatments of nitrogen bio-fertilization, i.e., without bio., Microbein and Nitrobein were applied individually or in combination with other treatments. The used bio-fertilization of bacteria were Microbein and Nitrobein which supplied by ARC, Giza, Egypt. The inoculation, with Microbein and Nitrobein was performed by mixing a soil with each product individually.

C. Nitrogen levels: The recommended dose of NPK (2:1:1) was divided in two equal parts, the first one was applied one month after transplanting and the second one was applied after the first cut. The chemical fertilizers were applied as Urea (46 %N) at 100 kg/ fed., calcium superphosphate (15.5% P_2O_5) at 150 kg/ fed and potassium sulphate (48 % K_2O) at 150 kg/ fed (recommended dose. Organic manure (compost) was added before agricultural and during prepare land for agriculture at ate of a recommended dose of N and according to each treatment. This experiment included three different levels of organic and mineral nitrogen fertilizers were as follow:

1) - 100 % Mineral N fertilizer + 0 % Compost.
2) - 50 % Mineral N fertilizer + 50 % Compost.
3) - 0 % Mineral N fertilizer + 100 % Compost

Experimental design

Each replicate included 18 treatments which were the combinations of two algae extract and three nitrogen bio- fertilizer treatments with three nitrogen levels of organic and mineral treatments. The split – split plots design with three replicates was used. The main plots were algae extract treatments, whereas, the sub plots were assigned for nitrogen bio- fertilizers and different levels of organic and mineral nitrogen fertilizers treatments were placed in the sub-sub plots. Data were subjected to proper statistical analysis according to Snedecor and Cochran, (1980).

Data recorded

I. Vegetative growth characteristics: A random sample of three plants was taken from each plot at 90 days after transplanting and the following data were recorded during the two seasons were as follow:

1- Plant length (cm).
2- Main leaf number per plant.
3- Side leaf number per plant
4- Head circumference (cm).
5- Fresh weight of leaves (g/plant)
6- Fresh weight of necks (g/plant)
7- Fresh weight of total plant (g/plant)
8- Dry weight of leaves (g/plant)
9- Dry weight of necks (g/plant).
10- Dry weight of total plant (g/plant)

II)-Total green leaf yield: All the plants every plot of the experiment was harvested at 90 days from transplanting and data were recorded as follow:
1) - Leaves yield as ton/fed. 2) - Necks yield as ton/fed 3)- Total whole plant as ton/fed.

III)- Quality of bundles: Data of quality celery bundles were recorded as follow:
1)- Head circumference. 2)- Mean weight of leaf head.

IV. Chemical content (Mineral nutrients)

Samples of the leaves of celery plants were taken at 90 days from transplanting then oven dried at 70 ^{o}C till constant weight and acid digested. The percentages of nitrogen, phosphorus and potassium in the acid digested samples of dry leaves and necks, were determined in dried leaves according to Cottenie *et al*. (1982).

IIV. Essential oil content: Hydro-distillation determined the quantitative of essential oil obtained from different treatments. Which, continued from 2.5 to 3 hours after the water boiling till no further increase in the oil volume was observed from the distillation of 100g fresh leaf samples. Then, the oil volume (ml/plant) was calculated as oil percentage x leaves fresh weight (g/plant). and the following data were recorded during the two seasons were as follow:
1)- Essential oil content (% V/ W). 2)- Essential oil content per plant (ml).
3)- Essential oil yield (Liter/ fed.).

IIIV. Gas chromatography – mass spectrometry (GC – MS) analysis

The essential oils were extracted separately by hydro-distillation method utilizing apparatus similar to European Pharmacopoeia (EP). Analysis of the oil samples were conducted by using a gas chromatography (Agilent 8890 GC System), coupled to a mass spectrometer (Agilent 5977B GC/MSD) and equipped with a HP-5MS fused silica capillary column (30 m, 0.25 mm, i.e., 0.25 mm film thickness). The oven temperature was maintained initially at 50 °C, then programmed from 50 to 200°C at a rate of 5°C/min and from 200°C to 280°C at a rate of 10°C/min, then held for 7 min at 280°C. Helium was used as the carrier gas, at flow rate of 1.0 mL/ min. The essential oil was dissolved in diethyl ether (20 µL essential oil / mL diethyl ether), and then 1 µL of this solution were injected in the GC with a split ratio 1:50. The temperature of injection was 230 °C. Mass spectra in the electron impact mode (EI) were obtained at 70 eV and scan m/z range from 39 to 500 amu. The isolated peaks were identified by matching them with data from the library of mass spectra (National Institute of Standard and Technology, NIST). The percentage of major constituents (Table, 27) were estimated by measuring the peak area of the different compounds of the chromatogram according to Heftman (1967) and Gunther and Joseph (1978). Sources of the principal components of volatile oils which used as reference for determined essential oil of celery by GC were: Ciba Gigi, NY, USA.

3. Results and Discussion

A)- Effect of spraying with algae extract

I) - Vegetative growth characters

Data presented in Table (3) show that the effect of spraying with algae extract on vegetative growth characters, i.e., plant length, main leaf number per plant, side leaf number per plant, head circumference (cm), fresh and dry weight of leaves, necks and total plant (g/plant). Foliar spraying of celery plants using algae extract significantly increased all the vegetative growth characteristics of celery plants represented in plant length, number of main and secondary leaves, fresh and dry weight of leaves, necks and total plant. Celery plants that were sprayed with algae extract on leaves recorded the highest rates of vegetative growth represented in above mentioned characters. and this is evident from Table (3).

Algae extracts can be used as a foliar application to improve vegetative growth because it contains nutrients such as N, P, K, Ca, Mg, S, in addition to Zn, Fe, Mn, Cu, Mo, Co, some growth regulators, polyamines and vitamins (Zhang and Ervin, 2004 and Papenfus *et al*., 2013), cytokinins, auxins, abscisic acid, vitamins and nutrients (Chojnacka and Kim, 2013).

However, similar effect and findings about spraying with algae extract were reported by (Mooney and Van Staden, 1985; Blunden, 1991). Application of seaweed extract has already been shown to enhance plant growth by Featonby and Van Staden (1983), Sivasankari *et al.,* (2006) and Abdel Mawgoud *et al.,* (2010) on watermelon.

Shehata *et al.,* (2011) On celery plants, it was found that the vegetative growth organs of celery plants, i.e., plant height and fresh and dry weight of leaves, were increased after the mixture of the original ingredients of amino acids and seaweed extract spray compared to the control plant. The growth resistance of the sea weed extract may be due to the presence of macro- and micro-grass materials, and is also due to the presence of some growth-promoting substances in the sea weed extract. Shams and Nahla Morsy (2019) reported that, spraying broccoli plants with the algal extract, improved significantly vegetative growth parameters as compared with the control treatment (only distilled water). Doaa Gad *et al*., (2023) showed that spraying different organic extracts spray gave significantly better vegetative growth than the control treatment (spraying water). The best parameters for plant height, number of leaves, leaf area, total plant fresh weight, plant dry matter and stem diameter of celery plants were obtained by spraying algae extract at a rate of 20 ml/L during the two study seasons.

II)-Total green leaf yield: It is clear from Table (4) that the use of algae extracts significantly increased the total green leaf yield of celery plants, as it recorded the highest values of leaf yield (compared to untreated plants), which reached (20.627 and 21.183 ton/ feddan) during the two growing seasons. The amount of crop increase was (4.343 and 4.217), with a percentage rate of (21.05% and 19.91%), during the two planting seasons, respectively.

(Blunden *et al*., 1991) Which increases the production of chlorophyll by enhancing the photosynthesis process, thus stimulating vegetative growth. Thus, the factory's performance improves and this is reflected in its productivity. However, our results are consistent with the findings of Beckett *et al.,* (1994) on bean, Arthur *et al.,* (2003) on pepper, Zodape *et al.,* (2008) on okra, Gajewski *et al.,* (2008) on Chinese cabbage Abdel Mawgoud *et al., (*2010) on water melon. Shehata *et al*., 2011 On celery plants, it was found that the highest green productivity was consistent with using the highest level of seaweed extract as the best treatment, which was significantly superior to the other spray treatments studied. This increase may be because the seaweed extract is a bio stimulant, which provides the celery plant with micro- and macronutrients and significant amounts of cytokinins, auxins, and betaines. Doaa Gad *et al*., (2023) showed that spraying different organic extracts spray gave a significantly better result than the comparison treatment (water spray). The best parameters for the productivity of celery plants were obtained by spraying algae extract at a rate of 20 ml/L.

III)- Quality bundles

Treatment of spraying with algae extract recorded high quality in celery bundles represented by an increase in the circumference of the bundle and an increase in the average weight of the bundle compared to the untreated (control plants) Table (3).

Foliar spraying with algae extracts improved celery yield characteristics and head quality compared to plants sprayed with distilled water. (Shams and Nahla Morsy, 2019 and Doaa Gad *et al*., 2023).

IV)- Essential oil yield

It is clear from Table (4) that the use of algae extracts led to a significant increase in the essential oil content of celery plants (percentage, plant content and essential oil yield (liter/ fed.) in fresh celery leaves, petioles and total plant. The highest values of essential oil yield were (8.556 and 10.332 liter/ fed.) compared to untreated plants (control) during the two growing seasons, respectively. The amount of oil yield increase was (3.880 and 4.084 liter/ fed.), a percentage of (45.35 and 39.53%), during the two growing seasons, respectively Doaa Gad *et al*., (2023). there were significant differences among different organic extracts sprayed on quality characteristics. Foliar application with algal extract gave the highest values of essential oil.

Table 3: Effect of Algae extract on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

A

Algae extract	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
					Leaves	Necks	Total	Leaves	Necks	Total
First season (2019/2020)										
Without	48.33	20.67	13.30	9.95	451.67	365.04	816.70	58.79	31.02	89.81
With	52.74	21.52	15.11	11.57	586.26	447.59	1033.85	76.59	33.22	109.80
L.S.D at $_{0.05}$	0.46	0.29	1.20	0.07	5.73	1.04	6.48	0.87	1.30	1.11
Second season (2020/2021)										
Without	50.56	21.33	14.30	10.53	471.81	376.48	848.30	59.37	31.99	91.36
With	54.93	23.37	16.26	12.13	597.33	461.81	1059.15	78.00	34.25	112.25
L.S.D at $_{0.05}$	**0.56**	**0.47**	**0.78**	**0.16**	**6.42**	**4.48**	**10.62**	**0.40**	**N.S.**	**1.25**

Table 4: Effect of Algae extract on green yield, essential oil content, essential oil yield and chemical content of celery during two seasons (2019/2020 and 2020/2021).

A

Algae extract	Yield of celery (ton/fed.)			Essential oil content % (V/W)		Essential oil content per plant (ml.)			Essential oil yield (Liter/ fed.)			Chemical content N	P	K
	Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
First season (2019/2020)														
Without	9.033	7.300	16.334	0.044	0.008	0.206	0.028	0.234	4.114	0.562	4.676	2.67	0.44	2.94
With	11.725	8.952	20.677	0.060	0.016	0.356	0.072	0.428	7.111	1.445	8.556	3.10	0.49	3.12
L.S.D at $_{0.05}$	0.215	0.074	0.216	0.003	0.001	0.016	0.003	0.015	0.325	0.060	0.304	0.01	0.01	0.01
Second season (2020/2021)														
Without	9.436	7.530	16.966	0.057	0.010	0.276	0.037	0.312	5.516	0.733	6.248	2.76	0.48	2.98
With	11.947	9.236	21.183	0.073	0.018	0.438	0.078	0.517	8.767	1.565	10.332	3.17	0.54	3.16
L.S.D at $_{0.05}$	**0.136**	**0.087**	**0.165**	**0.003**	**0.001**	**0.018**	**0.002**	**0.018**	**0.369**	**0.044**	**0.359**	**0.01**	**0.01**	**0.01**

IIV. Chemical content

It is clear from Table (4) that the use of algae extracts significantly increased in mineral content, i. e. N, P and K% in leaves of celery plants, as it recorded the highest values of mineral content (compared to untreated plants).

Similar effect of foliar spraying with seaweed extract on chemicals constitutes of celery plant were reported by Turan and Köse (2004), Mancuso *et al.,* (2006) and Rathore *et al.,* (2009). Meanwhile, the results disagree with those of Abo Sedera *et al.,* (2010) in concern to amino acid effect. The results were agreement with those of Abo Sedera *et al.,* (2010) regarding the beneficial effect of amino acids on N content. Regarding phosphorus content, the results indicated that the seaweed extract at the two tested levels led to a significant increase in phosphorus content compared to the control and other spraying treatments. While opposite results were observed for the higher level of amino acids, the lower level did not reflect any significant effect when compared to those found in the untreated test plants. Shehata *et al*., 2011 On celery plants, it was indicated that spraying plants with amino acids at both levels studied led to a significant increase in nitrogen content in leaf tissues compared to the spray treatments as well as other spray treatments, with a clear superiority at the higher level.Shams and Nahla Morsy (2019) the results showed that foliar application of algae cell extract (F1 and F2) led to a significant increase in nitrogen and potassium concentrations within the leaves and heads of broccoli plants during the two consecutive years.

IIIV. Active substances content (Major components percentage of essential oil):

Data presented in Table (5) show that the effect of spraying with algae extract on major components percentage of essential oil in leaves of celery plants, i.e., D-Limonene, trans-β-Ocimene, Carvacrol, β-Caryophyllene, β-Selinene, 3-Butylisobenzofuran-1(3H)-one, Sedanolide and trans-Sedanolide. Spraying with algae extracts led to a significant increase in the major component's percentage in essential oil of celery plants compared to without spray by algae extract which recorded a highest value of Carvacrol (%) reached to (9.19% and 9.20%), β-Caryophyllene (%) reached to (3.13 and 3.35), β-Selinene (%) reached to (5.00% and 5.22%), Sedanenolide (%) reached to (12.41% and 12.63%) and Trans-Sedanenolide (%) reached to (13.86% and 15.24%) during two growing seasons. On the other hand, without spray algae extract treatment recorded a significant deference in major component's percentages of essential oil content, i.e., D-Limonene (%) reached to (43.29% and 44.56%), Trans-β- Ocimene (%) reached to (9.98% and 10.40%) and 3-Butylisobenzo- furan 1(3H)-one (%) reached to (5.36% and 5.49%) during two seasons. The main constituents of the oil were limonene and myrcene. Celery leaf blades contained less limonene and more myrcene compared to petioles (Rożek *et al*., 2016).

Spraying with algae extract recorded the higher major components such as carvacrol (9.19% and 9.20); β-Caryophyllene (3.13% and 3.35); β-Selinene (5.00 and 5.22); Sedanolide (12.41 and 12.63) and Trans-Sedanolide (13.86% and 15.24) at the first and second seasons, respectively compared to without spray algae treatment.

B)- Effect of nitrogen bio-fertilization

I)- Vegetative growth characters

Data presented in Table (6) reported that, celery plants inoculated with bio-microbial fertilizers recorded the highest vegetative growth rates represented by plant length, main leaf number per plant, side leaf number per plant, head circumference (cm), fresh and dry weight of leaves, necks and total plant (g/plant). The vital fertilization of celery plants using Microbein as a bio-fertilizer which atmospheric nitrogen-fixing microbial bacteria resulted in a significant increase in the above-mentioned vegetative growth characters higher than the increase resulting from the use of Nitrobein inoculation compared to uninoculated plants (control).

Shams and Nahla Morsy (2019) The results showed that adding biofertilizer (N2) led to a significant improvement in plant height and fresh weight of broccoli plants. The previous results agree, to some extent, with the results of Rashed (2002) on parsley, Kandeel *et al.,* (2001), Mohamed and Abdu (2004) on *Foeniculum vulgare*; Zaki *et al*., (2012) on broccoli and Zenab Ahmed (2017) on celery and dill Plants.

Table 5: Effect of Algae extract on major components percentage of essential oil content of celery during two seasons (2019/2020 and 2020/2021).

	A							
Algae extract	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
	First season (2019/2020)							
Without	43.29	9.98	7.54	2.93	3.38	5.36	10.22	9.58
With	24.52	2.66	9.19	3.13	5.00	4.43	12.41	13.86
L.S.D at $_{0.05}$	**1.48**	**0.29**	**0.18**	**0.01**	**0.03**	**0.01**	**0.12**	**0.02**
	Second season (2020/2021)							
Without	44.56	10.40	7.51	3.13	3.60	5.49	10.44	10.94
With	25.58	3.20	9.20	3.35	5.22	4.44	12.63	15.24
L.S.D at $_{0.05}$	**1.48**	**0.11**	**0.12**	**0.01**	**0.02**	**0.01**	**0.10**	**0.07**

Table 6: Effect of nitrogen bio-fertilizers on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

	B									
Bio-Nitrogen fertilizers	**Plant length (cm)**	**Main leaf No./ plant**	**Side leaf No./ plant**	**Head circulenes (cm)**	**Fresh weight (g / plant)**			**Dry weight (g / plant)**		
					Leaves	**Necks**	**Total**	**Leaves**	**Necks**	**Total**
	First season (2019/2020)									
Without	52.74	23.56	13.81	10.85	486.19	372.26	858.44	56.02	28.95	84.97
Microbein	60.26	24.70	16.89	13.85	687.07	586.22	1273.30	95.68	44.46	140.14
Nitrobein	58.70	23.37	18.15	12.33	628.15	441.59	1069.74	83.20	37.11	120.30
L.S.D at $_{0.05}$	**0.98**	**0.80**	**0.71**	**0.38**	**10.77**	**4.23**	**10.81**	**2.09**	**2.11**	**3.00**
	Second season (2020/2021)									
Without	55.26	24.74	14.93	11.46	503.96	384.85	888.81	58.06	29.94	88.01
Microbein	62.74	25.89	18.15	14.50	711.33	602.52	1313.85	96.89	45.69	142.57
Nitrobein	61.00	25.11	19.33	12.96	639.26	482.74	1122.00	83.17	40.28	123.45
L.S.D at $_{0.05}$	**0.71**	**0.56**	**0.54**	**0.29**	**6.79**	**4.36**	**8.23**	**1.84**	**2.16**	**2.59**

II)-Total fresh leaf yield

It is clear from Table (7) that the use of bio-fertilizers inoculated significantly increased the green yield of celery plants. As shown, the use of Microbein inoculum as a source of bio-nitrogen fertilizer recorded the highest values of head yield, reaching (25.466 and 26.277 ton/ fed.) during the first and second seasons compared to using Nitrobein or uninoculated plants, respectively. The increasing of green yield reached (4.071 and 8.297 ton/ fed.), with a rate of (15.99% and 32.58%) during the first season, the amount of leaf yield was (3.838 and 8.501 tons / feddan), with a rate of (14.60% and 32.35%) during the second season.

Zaki *et al*., (2012) reported that inoculated broccoli plants with biofertilizer showed higher yield and its components than the untreated plants.

III)- Quality bundles

The use of Microbein fertilizer as a source of bio-nitrogen fertilizer recorded the highest values of the quality of celery bundles represented in the average weight of the bundle, circulenes of one bundle compared to the use of Nitrobein and uninoculated plants (control) Table (6). The use of Microbein inoculate led to an increase in the quality of the head's celery bundles represented in the values of bundle weight and circulenes, and this increase was the highest when using the Microbein inculcate, followed by plants inoculated with Nitrobein. Zaki *et al*., (2012) stated that inoculated plants with biofertilizer showed higher values of heads quality (weight, diameter and height) than the untreated plants. Similar effect of nitrogen bio-fertilizer on quality of celeriac plant were reported by Zenab Ahmed (2017).

IV)- Essential oil yield

It is clear from Table No. (7) that the use of bio-fertilizers resulted in a significant increase in the essential oil content of celery plants (percentage - content per plant - essential oil yield (liter/ fed.) in leaves and petioles of fresh and total plant of celery Where the highest values of leafy oil yield (compared to untreated plants) were recorded (8.963 and 11.328 liter/ fed.) during the two growing seasons, respectively. The oil yield increasing reached to 3.572 and 4.290 liters/ feddan), i.e., a percentage of (39.85% and 37.87%) compared to untreated plants during the two growing seasons, respectively. Nitrobein treatment comes in the second order compared to untreated plants.

IIV. Chemical content

It is clear from Table (7) that inoculation of Microbein as a source of bio-nitrogen fertilizer recorded a significant difference and gave a highest value of N, p and K % in leaves of celery plants compared to Nitrobein inoculator and non-inoculated plants (control) during two seasons. The lowest values of N, p and K % were recorded in plants without inoculation with biofertilization.

These results are in agreement with those obtained by Zaki *et al*., (2012) plants inoculated with biofertilizers showed the highest values of N; P and K in the tissues of leaves and heads of broccoli are more than in untreated plants.

IIIV. Active substances content (Major components percentage of essential oil)

Results in (Table, 8) showed that the effect of nitrogen bio-fertilization on major components percentage of essential oil in leaves of celery plants, i.e., D-Limonene, Trans-β-Ocimene, Carvacrol, β-Caryophyllene, β-Selinene, 3-Butylisobenzofuran-1(3H)-one, Sedanolide and trans-Sedanolide. Without bio-fertilizer treatment led to a significant increase in 3-Butylisobenzofuran-1(3H)-one compared to with bio-fertilizers which recorded the highest value (5.85% and 5.90%) at the first and second season respectively.

Bio-fertilizers increased values of some major component's percentage of essential oil in leaves of celery plants. Nitrobein treatment as a bio-fertilizer was superior in active substances content such as β-Caryophyllene, β-Selinene Sedanolide and trans-Sedanolide compared with other biofertilization treatments. Nitrobein treatment was superior in active substances content such as D-Limonene, Trans-β-Ocimene and Carvacrol % compared to other treatment. The results were similar in the two seasons. Similar findings were honorable (Zenab Ahmed, 2017) who reported that applied biofertilizers (CPP) gave the highest values of the major's chemical composition of essential oils i. e Apiol, Myristien, ß. Pinene, Limonene and ß- Phellandrene percentages during first cut of 2014/2015 seasons.

Table 7: Effect of nitrogen bio-fertilizers on green yield, essential oil conten, essential oil yield and chemical content of celery during two seasons (2019/2020 and 2020/2021).

Bio-Nitrogen fertilizers	Yield of celery (ton/fed.)			Essential oil content % (V/W)		Essential oil content per plant (ml.)			Essential oil yield (Liter/ fed.)			Chemical content N (%)	P (%)	K (%)
	Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total			
First season (2019/2020)														
Without	9.724	7.444	17.169	0.051	0.010	0.236	0.034	0.270	4.713	0.678	5.391	2.90	0.49	3.38
Microbein	13.741	11.724	25.466	0.060	0.013	0.379	0.069	0.448	7.580	1.383	8.963	3.46	0.56	3.47
Nitrobein	12.563	8.832	21.395	0.064	0.014	0.365	0.058	0.423	7.300	1.156	8.456	3.20	0.50	3.30
L.S.D at 0.05	**0.215**	**0.074**	**0.216**	**0.003**	**0.001**	**0.016**	**0.003**	**0.015**	**0.325**	**0.060**	**0.304**	**0.02**	**0.01**	**0.01**
Second season (2020/2021)														
Without	10.079	7.697	17.776	0.066	0.012	0.309	0.043	0.352	6.181	0.857	7.038	3.08	0.54	3.28
Microbein	14.227	12.050	26.277	0.074	0.015	0.483	0.083	0.566	9.663	1.665	11.328	3.62	0.60	3.60
Nitrobein	12.785	9.655	22.440	0.079	0.016	0.453	0.067	0.520	9.056	1.348	10.404	3.12	0.57	3.38
L.S.D at 0.05	**0.136**	**0.087**	**0.165**	**0.003**	**0.001**	**0.018**	**0.002**	**0.018**	**0.369**	**0.044**	**0.359**	**0.01**	**0.01**	**0.01**

Table 8: Effect of nitrogen bio-fertilizers on major components percentage of essential oil contentl of celery during two seasons (2019/2020 and 2020/2021).

Bio-Nitrogen fertilizers	D-Limonene	Trans-β-Ocimene	Carvacrol	β-Caryophyllene	β-Selinene	3-Butylisobenzo-furan 1(3H)-one	Sedanenolide	Trans-Sedanolide
First season (2019/2020)								
Without	36.72	8.88	9.76	3.38	4.20	5.85	13.69	15.52
Microbein	34.80	4.01	5.71	3.85	5.65	5.37	14.27	15.76
Nitrobein	38.12	9.30	15.63	3.04	4.39	5.20	13.43	11.03
L.S.D at 0.05	**0.66**	**0.16**	**0.09**	**0.01**	**0.02**	**0.01**	**0.07**	**0.02**
Second season (2020/2021)								
Without	38.06	9.24	9.69	3.61	4.44	6.00	13.93	17.05
Microbein	36.27	4.59	5.71	4.09	5.90	5.39	14.51	17.30
Nitrobein	39.23	9.93	15.67	3.29	4.64	5.35	13.68	12.54
L.S.D at 0.05	**0.42**	**0.10**	**0.05**	**0.02**	**0.01**	**0.01**	**0.07**	**0.07**

C)- Effect of nitrogen fertilizer rates and sources

I) - Vegetative growth: characters

It is clear from Table (9) that the mixed rate of mineral and organic nitrogen fertilizer (50% mineral + 50% organic) of the recommended dose of nitrogen fertilization recorded the highest values of vegetative growth characteristics, i.e., plant length, main leaf number per plant, side leaf number per plant, head circumference (cm), fresh and dry weight of leaves, necks and total plant (g/plant) compared to other rates.

Increasing the rates of organic nitrogen fertilization led to a significant increase in the vegetative growth characteristics of celery plants represented in above mentioned. The addition of the mixed rate of organic and mineral nitrogen fertilizer for plants (50% mineral + 50% organic) of the recommended amount of nitrogen/ feddan was recorded a highest increase in the above-mentioned characteristic of. Followed at that rate by 100% organic alone from the recommended dose of nitrogen. The lowest values of these traits were for plants that were fertilized with 100% mineral fertilizer of the recommended dose of nitrogen (Zaki *et al*., 2012). concerning the rates of nitrogen sources, application of 75% organic + 25% mineral resulted in highest vegetative growth of broccoli plants. Lower values of plant growth were obtained by applying 100% mineral fertilizer alone. Hanaa Abd-Alrahman *et al*., (2016) She explained that the fertilizer formula of 75% mineral + 25% organic from the recommended fertilizer units showed the highest values of total heads productivity, mineral content of P, K, Ca, Mg and nutritional value of heads compared to other treatments.

II)-Total fresh leaf yield

It is clear from Table (10) that the mixed rate of nitrogen fertilizer (50% mineral + 50% organic) of the recommended dose of nitrogen/ fed. has recorded the highest amount of the main leaf yield compared to rates of 100% organic or 100% mineral from recommended dose of N. Plants which treated with the mixed rate of mineral and organic nitrogen fertilizer (50% mineral + 50% organic) recorded the highest values of the total leaf yield per feddan (22.493 and 23.140 ton/ fed.), outperforming the rest of the other treatments, followed by the rate treatment of 100% organic of the recommended dose of nitrogen. This increase reached to (4.459 and 3.763 ton/ fed.) with a rate of (19.82% and 16.26%) during two seasons respectively. The lowest treatments in the total leaf yield were the treatment of mineral nitrogen fertilization (100% mineral), which reached (14.989 and 14.707 ton/ fed.). The value of superiority was (7.504 and 8.433 ton/ fed.), i.e. (33.36% and 36.44%) during two seasons respectively.

These results are agreement with those obtained by Hanaa Abd-Alrahman *et al*., (2016) she explained that the fertilizer formula 75% mineral + 25% organic of the recommended fertilizer units showed the highest total head yield values for broccoli plants. This can be attributed to increased absorption of nutrients due to the combined effect of mineral fertilizers (more soluble and available to plants) and organic fertilizers (which have different dynamics). availability of nutrients) (Jen *et al*., 2008). Using a fertilizer formula consisting of organic and mineral fertilizers works to improve the soil's ability to retain moisture and increase the nutrient content of the soil solution and the efficiency of using nutrients from organic and mineral fertilizers (Abou El-Magd *et al*., 2009).

III)- Quality bundles

Data presented in Table (9) shows that the rates and sources of nitrogen fertilizer are to obtain a high significant increase in all quality traits represented in the weight and circumference of the celery bundle. The addition of the mixed ratio of mineral and organic nitrogen fertilizer (50% mineral + 50% organic) of the recommended dose of nitrogen significantly improved the quality of celery bundles represented by average bundle weight and head circumference, followed by 100% organic treatment, then 100% mineral treatment. The lowest values for all of these traits were obtained from fertilizing with celery with 100% mineral (recommended dose).

IV)- Essential oil yield

It is clear from Table (10) that the use of the mixed rate of nitrogen fertilizer (50% mineral + 50% organic) of the recommended dose of N/ fed. resulted in a significant increase in the essential oil content of celery plants (percentage - content per plant - essential oil yield (liter/ fed.) in the leaves,

Table 9: Effect of nitrogen fertilizer rates of recommended dose on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

Nitrogen fertilizer rates (Recommended dose)	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
					Leaves	Necks	Total	Leaves	Necks	Total
First season (2019/2020)										
100 % Mineral N fertilizer	45.67	19.11	11.94	9.03	411.67	337.78	749.44	53.79	26.93	80.72
50 % Mineral N fertilizer + 50 % Compost	54.94	22.72	16.22	12.55	628.17	496.50	1124.67	82.73	38.72	121.45
100 % Compost	51.00	21.44	14.44	10.71	517.06	384.67	901.72	66.55	30.70	97.25
L.S.D at 0.05	**0.47**	**0.64**	**0.46**	**0.32**	**8.37**	**4.76**	**7.87**	**1.68**	**1.46**	**2.33**
Second season (2020/2021)										
100 % Mineral N fertilizer	47.94	20.50	13.06	9.59	425.61	309.72	735.33	54.92	24.85	79.77
50 % Mineral N fertilizer + 50 % Compost	57.06	23.94	17.33	13.11	646.28	510.72	1157.00	83.44	39.84	123.27
100 % Compost	53.22	22.61	15.44	11.29	531.83	437.00	968.83	67.70	34.67	102.37
L.S.D at 0.05	**0.42**	**0.32**	**0.37**	**0.24**	**6.02**	**4.02**	**8.18**	**1.71**	**1.44**	**2.19**

Table 10: Effect of nitrogen fertilizer rates of recommended dose on green yield, essential oil content, essential oil yield and chemical content of celery during two seasons (2019/2020 and 2020/2021).

Nitrogen fertilizer rates (Recommended dose)	Yield of celery (ton/fed.)			Essential oil content % (V/W)		Essential oil content per plant (ml.)			Essential oil yield (Liter/ fed.)			Chemical content N	P	K
	Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
First season (2019/2020)														
100 % Mineral N fertilizer	8.233	6.754	14.989	0.052	0.016	0.214	0.060	0.274	4.283	1.196	5.480	2.98	0.45	2.93
50 % Mineral N fertilizer + 50 % Compost	12.563	9.930	22.493	0.061	0.010	0.389	0.053	0.442	7.787	1.056	8.843	2.74	0.44	2.97
100 % Compost	10.341	7.693	18.034	0.044	0.010	0.238	0.038	0.276	4.766	0.758	5.524	2.94	0.50	3.18
L.S.D at 0.05	**0.167**	**0.083**	**0.157**	**0.003**	**0.000**	**0.018**	**0.003**	**0.018**	**0.351**	**0.052**	**0.361**	**0.01**	**0.01**	**0.01**
Second season (2020/2021)														
100 % Mineral N fertilizer	8.512	6.194	14.707	0.064	0.018	0.275	0.054	0.329	5.497	1.089	6.586	3.06	0.49	3.03
50 % Mineral N fertilizer + 50 % Compost	12.926	10.214	23.140	0.074	0.012	0.486	0.065	0.550	9.713	1.293	11.006	2.86	0.48	2.95
100 % Compost	10.637	8.740	19.377	0.057	0.012	0.311	0.053	0.364	6.215	1.064	7.279	2.98	0.55	3.22
L.S.D at 0.05	**0.120**	**0.080**	**0.164**	**0.004**	**0.000**	**0.024**	**0.001**	**0.024**	**0.471**	**0.028**	**0.476**	**0.02**	**0.01**	**0.01**

petioles and whole plant of fresh celery plants. The highest values of essential oil yield were recorded by (50% mineral + 50% organic) of the recommended dose of N/ fed. compared to other treatments, which reached (8.843 and 11.006 liter/fed.) during the two growing seasons, respectively. The yield increase was (3.336 and 4.420 liter/fed.), i.e., by a percentage of (37.70% and 40.16%) compared to 100% mineral + 0% organic treatment in both growing seasons, respectively.

These results are in agreement with those obtained by Zenab Ahmed (2017) showed that all treatments of fertilization, affected oil percentage in both seasons of celery and dill plants. The highest mean values of oil percentage in most cases, resulted from the treatments of 50% NPK in both seasons. Similar results, more or less were obtained by Kandeel *et al.,* (2001) and Abou El- Maged *et al.,* (2008) on sweet fennel plants.

IIV. Chemical content

It is clear from Table (10) that the rate of nitrogen fertilizer sources (100% Mineral N fertilizer + 0 % Compost) treatment recorded the highest values of N% in leaves of celery plants compared to other rates. The rate of nitrogen fertilizer (0 % Mineral N fertilizer + 100 % Compost) treatment recorded the highest values of P% and K% in leaves of celery plants compared to other treatments. These results are similar in two seasons.

When the ratio of organic manure in fertilization equation increases the mineral content of elements increase So, similar results were reported by (Zaki *et al*., 2012). found that nitrogen source rates and addition of 75% organic + 25% mineral resulted in the highest vegetative growth. Lower plant growth values were obtained by using 100% mineral fertilizers alone.

Hanaa Abd-Alrahman *et al*., (2016) the results indicated that the equation of 75% mineral + 25% organic fertilizer units leads to an increase in the mineral content of the primary crops (P, K, Ca and Mg) in addition to the primary, secondary and total yields. The lowest values were recorded with a mineral formula of 25% + 75% of the recommended fertilizer dose.

IIIV. Active substances content (Major components percentage of essential oil)

Results in (Table 11) showed that the effect of nitrogen sources rates on major components percentages of essential oil in leaves of celery plants, i.e., D-Limonene, trans-β-Ocimene, Carvacrol, β-Caryophyllene, β-Selinene, 3-Butylisobenzofuran-1(3H)-one, Sedanolide and trans-Sedanolide. Treatment of 0 % Mineral N fertilizer + 100 % Compost led to a significant increase in the major component's percentage such as D-Limonene in essential oil of celery plants compared to other nitrogen sources rates. Average rate of 50% Mineral N fertilizer + 50% Compost was superior in active substances content such as Carvacrol (15.56% and 15.54%) and 3-Butylisobenzofuran-1(3H)-one (4.98% and 5.11%) compared to other treatment during two seasons respectively. The results were similar in the two seasons. High rate of organic fertilizer gave the highest values of the major components percentages of essential oil content in leaves of celery plants, i.e., Trans-β-Ocimene (7.23% and 7.29%), β-Caryophyllene (3.24% and 3.27%), β-Selinene (4.42% and 4.62%), Sedanolide (14.92% and 15.13%) and trans-Sedanolide (15.37% and 16.75%) at the first and second season, respectively.

Similar results were reported by Ismail *et al.,* (2009) on majoram plant; Darzi *et al* (2011) on anisum and. (Zenab Ahmed, 2017) indicated that the use of fertilization treatments had a significant effect on the proportion of the studied specialty major's compounds percentage of celery and dill oils.

D)- Effect of the interaction (Algae extract x Bio-nitrogen fertilization)

I)-Vegetative growth: characters

Data showed in Table (12) reported that most of the vegetative growth characteristics of celery plants were significantly affected by the interaction between spraying seaweed extract and bio-nitrogen fertilization, where the interaction recorded significant differences in each of plant length, side leaf number (secondary leaves) per plant, fresh and dry weight of leaves, petioles and whole plant. The application of spraying seaweed extract with the inoculant of Microbein as a bio-fertilizer recorded the highest values of vegetative growth of celery plants with significant differences with in most of the traits except for the number of main leaves and bundle circulenes without significant differences and followed by spraying seaweed extract + Nitrobein inoculate treatment compared to control (non-inoculation).

Table 11: Effect of nitrogen fertilizer rates of recommended dose on major components percentage of essential oil content of celery during two seasons (2019/2020 and 2020/2021).

	C							
Nitrogen fertilizer rates (Recommended dose)	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
				First season (2019/2020)				
100 % Mineral N fertilizer	38.99	4.64	3.54	2.77	3.79	4.74	5.80	6.85
50 % Mineral N fertilizer + 50 % Compost	27.92	7.10	15.56	3.07	4.37	4.98	13.22	12.94
100 % Compost	34.81	7.23	5.99	3.24	4.42	4.96	14.92	15.37
L.S.D at 0.05	**0.44**	**0.15**	**0.04**	**0.01**	**0.02**	**0.01**	**0.06**	**0.02**
				Second season (2020/2021)				
100 % Mineral N fertilizer	40.08	5.17	3.53	2.96	4.01	4.69	6.03	8.20
50 % Mineral N fertilizer + 50 % Compost	29.01	7.54	15.54	3.30	4.60	5.11	13.45	14.32
100 % Compost	36.13	7.69	5.99	3.47	4.64	5.10	15.13	16.75
L.S.D at 0.05	**0.34**	**0.17**	**0.04**	**0.02**	**0.01**	**0.03**	**0.07**	**0.04**

Table 12: Effect of the interaction between algae extract and nitrogen bio-fertilizers on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

					A x B					
Algae extract	**Bio-Nitrogen fertilizers**	**Plant length (cm)**	**Main leaf No./ plant**	**Side leaf No./ plant**	**Head circulenes (cm)**	**Fresh weight (g / plant)**			**Dry weight (g / plant)**		
						Leaves	**Necks**	**Total**	**Leaves**	**Necks**	**Total**
						First season (2019/2020)					
Without	**Without**	31.17	15.42	8.92	6.46	264.33	180.58	444.92	29.91	14.46	44.37
	Microbein	39.17	15.75	9.00	8.10	383.83	353.17	737.00	52.16	27.94	80.10
	Nitrobein	38.42	15.33	12.00	7.83	368.08	287.58	655.67	50.22	27.38	77.60
With	**Without**	38.58	15.42	8.83	7.79	363.50	292.42	655.92	42.54	21.94	64.48
	Microbein	41.00	17.33	13.08	9.96	519.67	405.75	925.42	74.22	29.87	104.09
	Nitrobein	39.08	15.67	12.08	8.29	435.92	308.92	744.83	55.55	22.94	78.49
L.S.D at $_{0.05}$		**1.39**	**N.S.**	**1.01**	**N.S.**	**15.23**	**5.98**	**15.29**	**2.95**	**2.98**	**4.24**
						Second season (2020/2021)					
Without	**Without**	32.83	15.33	9.67	6.92	275.83	187.92	463.75	31.21	15.06	46.26
	Microbein	40.83	16.58	9.75	8.52	403.67	363.00	766.67	52.16	28.73	80.89
	Nitrobein	40.08	16.08	12.75	8.25	382.08	296.17	678.25	50.22	28.19	78.40
With	**Without**	40.25	17.17	9.58	8.17	375.83	302.25	678.08	43.98	22.68	66.66
	Microbein	42.75	18.08	14.00	10.42	530.75	418.08	948.83	75.81	30.76	106.56
	Nitrobein	40.58	17.33	13.00	8.71	437.42	318.75	756.17	55.71	23.63	79.33
L.S.D at $_{0.05}$		**1.00**	**N.S.**	**0.76**	**N.S.**	**9.60**	**6.16**	**11.63**	**2.60**	**3.05**	**3.67**

Seaweed extracts have been marketed as organic fertilizers and have beneficial results (Khan *et al*., 2009). They noted that the value of seaweeds as fertilizers is due not only to the nitrogen, phosphorus and potash content, but also to the presence of trace elements. These extracts promote growth, production and absorption of nutrients by plants (Taha *et al*., 2011; Mona and Abou El-Goud 2021). The extract also contained hormones like (IAA and IBA), cytokinins, trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni), vitamins and amino acids (AbouEl-Yazied *et al*., 2012).

II)-Total fresh leaf yield

It is clear from Table (13) that the interaction between seaweed extract and bio-nitrogen fertilization resulted in a significant increase in leaf yield of celery plants. The interaction between spraying algae extracts and Microbein inoculated resulted in the highest values of total leaf yield per feddan (18.508 and 18.977 ton/ fed.) at the first and second season, respectively compared to other interaction treatments. This increasing reached to (9.610 and 9.702 ton/ fed.) with a rate of (51.92% and 51.13%) compared to control (without algae extract and without bio-fertilization treatment, during two seasons respectively. The lowest yield values were obtained from the interaction between not sprayed with algae extract and without bio-fertilization treatment.

III)- Quality bundles

The interaction between spraying with algae extract and Microbein as a bio-fertilizer resulted in obtaining the highest values for the average weight and head circumference of celery plant, compared to the rest of the interaction treatments, which recorded lower values represented in the average weight of the bundles and its circumference Table (12).

IV)- Essential oil yield

It is clear from Table (13) that the use of the mixed rate between spraying with algae extract and bio-nitrogen fertilization (Microbein) resulted in a significant increase in the essential oil content, i. e. % (V/W), per plant (ml.) and per liter/ fed. in leaves, petioles and whole plant of celery. The highest values of oil yield (compared to untreated plants) were recorded (7.451 and 9.067 liters / feddan) during two growing seasons, respectively. These increasing reached to 5.440 and 6.169 ton/ fed. at a rate of 73.01 % and 68.03 % in both growing seasons, respectively. The interaction between spraying with algae extract and bio-nitrogen fertilization (Nitrobein) came in the second order.

IIV. Chemical content

It is clear from Table (13) that the interaction between spraying with algae extract and Microbein as a bio-fertilizer resulted a significant difference and gave a highest value of N%, P% and K% in leaves of celery plants compared to other interactions. The lowest values of mineral content, i. e. N%, P% and K% was recorded by the interaction of spraying without algae extract and without bio-fertilization treatment. The results were similar in two growing seasons.

IIIV. Active substances content (Major components percentage of essential oil)

Results in (Table, 14) showed that the effect of nitrogen bio-fertilization on major components percentage of essential oil in leaves of celery plants, i.e., D-Limonene, Trans-β-Ocimene, Carvacrol, β-Caryophyllene, β-Selinene, 3-Butylisobenzofuran-1(3H)-one, Sedanolide and trans-Sedanolide. The interaction between without spray by algae extract and without bio- fertilizer treatment led to a significant decrease in the major component's percentage in essential oil of celery plants. Also, without spray by algae extract and without bio-fertilizers recorded a significant deference in a major component's percentages of essential oil content, i.., D-Limonene (%) reached to (36.77% and 37.57%) and 3-Butylisobenzo- furan 1(3H)-one (%) reached to (5.49% and 5.59%) during two growing seasons respectively. When algae extract was sprayed with application of bio-fertilizers increased values of major components percentage and major components percentage of essential oil in leaves of celery plants. The interaction between without algae extract and Nitrobein recorded a highest value of the major Trans-β- Ocimene (%) reached two (9.74% and 10.18%) during two growing seasons respectively. The interaction between spraying algae extracts and Nitrobein as a biofertilizer gave a highest value of Carvacrol (%) reached to (11.39% and 11.42%) at the first and second seasons respectively. Also, the interaction between spraying algae extracts and without biofertilizer gave a

Table 13: Effect of the interaction between algae extract and nitrogen bio-fertilizers on green yield, essential oil conten, essential oil yield and chemical content of celery during two seasons (2020/2019 and 2020/2021).

A x B															
Algae extract	**Bio-Nitrogen fertilizers**	**Yield of celery (ton/fed.)**			**Essential oil content**					**Essential oil yield (Liter/ fed.)**			**Chemical content**		
					% (V/W)		**per plant (ml.)**						**N**	**P**	**K**
		Leaves	**Necks**	**Total**	**Leaves**	**Necks**	**Leaves**	**Necks**	**Total**	**Leaves**	**Necks**	**Total**	**(%)**	**(%)**	**(%)**
First season (2019/2020)															
Without	**Without**	5.287	3.610	8.898	0.026	0.006	0.089	0.012	0.101	1.779	0.232	2.011	1.83	0.29	2.33
	Microbein	7.677	7.063	14.740	0.036	0.007	0.185	0.029	0.214	3.694	0.586	4.280	2.17	0.36	2.19
	Nitrobein	7.362	5.752	13.113	0.038	0.006	0.189	0.022	0.211	3.783	0.447	4.230	2.01	0.33	2.09
With	**Without**	7.270	5.848	13.118	0.043	0.009	0.212	0.034	0.246	4.242	0.679	4.922	2.01	0.35	2.20
	Microbein	10.393	8.115	18.508	0.044	0.012	0.310	0.063	0.373	6.192	1.259	7.451	2.56	0.40	2.50
	Nitrobein	8.718	6.178	14.897	0.049	0.015	0.278	0.066	0.344	5.566	1.312	6.878	2.41	0.34	2.31
L.S.D at 0.05		**0.305**	**0.105**	**0.306**	**0.005**	**0.001**	**0.023**	**0.004**	**0.022**	**0.460**	**0.085**	**0.430**	**0.02**	**0.01**	**0.01**
Second season (2020/2021)															
Without	**Without**	5.517	3.758	9.275	0.036	0.008	0.129	0.016	0.145	2.577	0.321	2.898	1.88	0.32	2.12
	Microbein	8.073	7.260	15.333	0.046	0.008	0.249	0.037	0.287	4.988	0.749	5.737	2.26	0.39	2.36
	Nitrobein	7.642	5.923	13.565	0.047	0.007	0.242	0.029	0.271	4.846	0.578	5.424	2.06	0.36	2.22
With	**Without**	7.517	6.045	13.562	0.052	0.010	0.268	0.041	0.310	5.370	0.823	6.193	2.29	0.38	2.23
	Microbein	10.615	8.362	18.977	0.053	0.013	0.380	0.073	0.453	7.601	1.466	9.067	2.66	0.43	2.53
	Nitrobein	8.748	6.375	15.123	0.059	0.017	0.338	0.062	0.399	6.755	1.232	7.987	2.20	0.40	2.34
L.S.D at 0.05		**0.192**	**0.123**	**0.233**	**0.005**	**0.001**	**0.026**	**0.003**	**0.025**	**0.522**	**0.062**	**0.508**	**0.02**	**0.01**	**0.01**

Table 14: Effect of the interaction between algae extract and nitrogen bio-fertilizers on major components percentage of essential oil content of celery during two seasons (2019/2020 and 2020/2021).

A x B									
Algae extract	**Bio-Nitrogen fertilizers**	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
First season (2019/2020)									
Without	**Without**	36.77	9.19	6.34	1.31	1.80	5.49	5.75	7.87
	Microbein	28.73	3.52	4.20	2.43	2.50	3.45	9.85	9.08
	Nitrobein	31.92	9.74	6.43	2.84	3.30	3.11	7.40	4.61
With	**Without**	13.99	1.80	5.33	3.29	4.10	3.22	11.10	12.17
	Microbein	17.28	1.94	3.95	2.23	4.13	2.93	8.06	9.50
	Nitrobein	23.90	2.26	11.39	1.54	3.03	3.82	8.76	9.51
L.S.D at 0.05		0.93	0.23	0.13	0.02	0.03	0.01	0.11	0.03
Second season (2020/2021)									
Without	**Without**	37.57	9.31	6.26	1.42	1.97	5.59	5.91	8.88
	Microbein	29.98	3.91	4.19	2.60	2.68	3.55	10.02	10.09
	Nitrobein	32.72	10.18	6.44	3.02	3.47	3.22	7.57	5.64
With	**Without**	14.86	2.22	5.34	3.46	4.27	3.33	11.27	13.23
	Microbein	18.04	2.33	3.96	2.39	4.29	2.75	8.22	10.55
	Nitrobein	24.66	2.66	11.42	1.70	3.20	3.92	8.92	10.51
L.S.D at 0.05		0.60	0.14	0.07	0.02	0.02	0.02	0.10	0.10

highest value of β-Caryophyllene (%) reached to (3.29% and 3.46%), Sedanenolide (%) reached to (11.10% and 11.27%) and Trans- Sedanolide (%) reached to (12.17% and 13.23%) at the first and second seasons respectively. The interaction between spraying algae extracts and Microbein as a bio-fertilizer gave a highest value of β-Selinene (%) reached to (4.13% and 4.29%) during two seasons respectively. Applied biofertilizer (CPP) + 50% NPK gave the highest major's chemical composition of essential oils. i. e Apiol, Myristien, ß. Pinene, Limonene and ß- Phellandrene percentages during first cut of 2014/2015 season (Zenab Ahmed, 2017).

E)- Effect of the interaction (Bio-nitrogen fertilization x Nitrogen fertilizers rates)

I) - Vegetative growth characters

Most of the vegetative growth characteristics of celery plants were significantly affected by the interaction between nitrogenous bio-fertilization and rates of nitrogen fertilizers sources, where significant differences were recorded in most of the vegetative growth characteristics represented in most of the vegetative growth, i. e. plant length main and secondary leaves, bundle circulene, fresh and dry weight of the leaves, petioles, and whole plant except for plant length in the first season did not reached to the significant level, Table (15).

Zeinab Salama (2015) was reported that the bulb productivity of both sweet fennel varieties increased significantly as a result of organic and bioorganic treatments. Organic and bio-organic fertilizers showed the highest production value (7.40 and 8.85 tons/ fed.) for the Dolce variety and (8.08 and 9.16 tons/ fed.) for the Zefa fino variety, respectively, compared to the control (5.90 and 7.07 tons/acre) of both cultivars. Zenab Ahmed (2017) The results indicated that the 50% NPK + biofertilizer (CPP) and 100% NPK (CPP) treatments led to a significant increase in plant height and fresh and dry weight in both seasons. While the least amount of growth occurred with the CPP treatment alone. The positive effect on the response of growth traits to biofertilizers can be attributed to increased moderation in plant tissues (Opera and Asigebu 1996). Also, nitrogen fixing bacteria may increase the synthesis of endogenous plant hormones, i.e., IAA, GAs and CKs which play an important role in forming a large active root system allowing more nutrients, soil uptake and finally accelerated plant growth.

Shams and Nahla Morsy (2019) revealed that the treatment containing 50% organic-N + 50% inorganic-N + biofertilizer (N4) resulted in significantly greater incremental increases in investigated nutrient concentrations within the heads and shoots of broccoli plants compared to other nitrogen fertilizer sources. The previous results agree, more or less, with the findings of Rashed (2002) on parsley and Kandeel *et al.,* (2001), Zaki *et al.,* (2012) on broccoli and Zeinab Salama (2015) on sweet fennel.

II)-Total fresh leaf yield

The results showed in Table (16) that the interaction between bio-nitrogen fertilization and nitrogen fertilizer rates resulted in a significant increase in leaf yield in celery plants. The interaction between the mixed rate of mineral and organic nitrogen fertilization (50% mineral + 50% organic) of the recommended dose with inoculation by Microbein resulted in obtaining the highest values for the total leaf yield per feddan, compared to the rest of the interaction treatments, followed by the treatment of the mixed rate of mineral nitrogen fertilization and Organic (50% mineral + 50% organic) from the recommended amount with Nitrobein inoculator.

The highest values of oil yield (compared to untreated plants) were recorded (26.550 and 27.597 ton/ feddan) during two growing seasons, respectively. These increasing reached to 15.743 and 16.244 ton/ fed. at a rate of 59.30 % and 58.86 % in both growing seasons, respectively compared to the interaction between without inoculation biofertilization and 100 % Mineral N fertilizer + 0 % Compost. The lowest yield values were those resulting from the interaction between 100% mineral + 0 compost of the recommended amount and without bio-fertilization, Table (16).

III)- Quality bundles

The interaction between nitrogen bio-fertilization and the ratios of nitrogen fertilizers sources to a significant increase in the quality of the leaf yield in celery plants, represented by the average weight of the bunch and bundles circulenes of celery, Table (15). The interaction between average level of mineral and organic fertilizer (50% mineral + 50% organic and Microbein as a microbial fertilization recorded the highest values of average weight of the bunch and bundles circulenes of celery bundles compared to other interactions coefficients, which recorded lower values for the quality of celery

Table 15: Effect of interaction (N bio-fertilizers x Nitrogen rates on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

B x C

Bio-N fertilizers	Nitrogen fertilizer rates	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
						Leaves	Necks	Total	Leaves	Necks	Total
						First season (2019/2020)					
Without	100 % Mineral N fertilizer	41.67	17.33	8.83	8.18	323.50	216.83	540.33	37.71	15.33	53.04
	50 % Mineral N fertilizer + 50 % Compost	50.83	23.00	15.00	10.67	540.17	425.17	965.33	61.05	32.61	93.66
	100 % Compost	47.00	21.33	11.67	9.65	392.00	304.00	696.00	46.15	24.86	71.01
Microbein	100 % Mineral N fertilizer	49.50	21.17	12.33	9.92	522.17	397.67	919.83	74.98	31.16	106.14
	50 % Mineral N fertilizer + 50 % Compost	57.67	23.33	16.17	14.48	730.67	596.83	1327.50	94.64	43.22	137.86
	100 % Compost	53.17	21.67	15.67	11.72	554.17	523.33	1077.50	83.16	41.23	124.39
Nitrobein	100 % Mineral N fertilizer	45.83	18.83	14.67	9.00	389.33	398.83	788.17	48.68	34.29	82.97
	50 % Mineral N fertilizer + 50 % Compost	56.33	21.83	17.50	12.50	613.67	467.50	1081.17	92.50	40.34	132.84
	100 % Compost	52.83	21.33	16.00	10.75	605.00	326.67	931.67	70.35	26.01	96.36
L.S.D at 0.05		**N.S.**	**1.27**	**1.14**	**0.60**	**17.16**	**6.74**	**17.23**	**3.32**	**3.35**	**4.78**
						Second season (2020/2021)					
Without	100 % Mineral N fertilizer	43.67	18.67	9.83	8.77	338.83	228.83	567.67	39.46	16.18	55.64
	50 % Mineral N fertilizer + 50 % Compost	52.83	24.00	16.00	11.25	558.83	437.17	996.00	63.17	33.54	96.72
	100 % Compost	49.67	22.33	12.67	10.15	405.67	314.33	720.00	47.74	25.74	73.48
Microbein	100 % Mineral N fertilizer	52.00	22.17	13.33	10.50	536.67	413.00	949.67	75.88	32.36	108.24
	50 % Mineral N fertilizer + 50 % Compost	60.00	24.50	17.50	14.98	766.00	613.83	1379.83	96.04	44.43	140.47
	100 % Compost	55.17	22.67	16.67	12.38	566.17	535.33	1101.50	84.02	42.18	126.20
Nitrobein	100 % Mineral N fertilizer	48.17	20.67	16.00	9.50	401.33	287.33	688.67	49.41	26.00	75.41
	50 % Mineral N fertilizer + 50 % Compost	58.33	23.33	18.50	13.08	614.00	481.17	1095.17	91.11	41.53	132.63
	100 % Compost	54.83	22.83	17.00	11.33	623.67	461.33	1085.00	71.33	36.10	107.43
L.S.D at 0.05		**1.13**	**0.89**	**0.86**	**0.47**	**10.82**	**6.94**	**13.10**	**2.92**	**N.S.**	**4.13**

bundles. The least treatment was the reaction treatment between the level (100% mineral of the recommended amount) without inoculation by bio-fertilizers.

IV)- Essential oil yield

It is clear from Table (16) that the use of the mixed rate between the nitrogenous bio-fertilization (Microbein) and the medium rate treatment of the azote fertilizer (50% mineral + 50% organic of the recommended dose) led to a significant increase in most of the essential oil content of celery plants (percentage - content per plant - essential oil yield (liter/ fed.) in the leaves and petioles of fresh green celery and whole plant, where the highest values were recorded for the yield of leafy oil compared to control (without inoculation biofertilization and 100 % Mineral N fertilizer) as it reached to 10.480 and 13.266 liter/ fed. during the two planting seasons, respectively, the amount of crop increase was 7.011 and 8.575 liter/ fed., i.e. by a percentage of (66.90% and 64.64%) in both planting seasons, respectively

The highest average oil percentage in most cases was the result of biofertilizer treatments (CPP) + 50% NPK in both seasons. The lowest percentage of oil resulted from (CPP) treatment without NPK (Zenab Ahmed, 2017). Increasing essential oil yield in plant leaves using biofertilizer treatments (CPP) and half dose of NPK; This may be due to increased occupancy of the root zone of the plant as a result of adding fertilization treatments, which is reflected in the plants' absorption of nutrients and confirms previous vegetative growth. Similar results were obtained, more or less. Similar results, more or less were obtained by Kandeel *et al.,* (2001) and Abou El- Maged *et al.,* (2008) on fennel plant.

IIV. Chemical content

The results showed in Table (16) that mixed rate between the nitrogenous bio-fertilization (Microbein) and the high rate of organic manure (0 % Mineral N fertilizer + 100 % Compost of the recommended dose) led to a significant increase in mineral content of N% and P% in leaves of celery plants. The interaction between Nitrobein as a bio- fertilizer and 0 % Mineral N fertilizer + 100 % Compost treatment gave a highest value of K% in leaves of celery plants at the first season but at the second season, the interaction between Microbein treatment and 100 % Mineral N fertilizer + 0 % Compost gave the highest values of K% in leaves. The lowest values of N%, P% and K% in leaves were recorded in the interaction of without biofertilization and 100 % Mineral N fertilizer + 0 % Compost treatment.

IIIV. Active substances content (Major components percentage of essential oil)

It is clear from Table (17) that the use of the mixed rate between the nitrogenous bio-fertilization (Microbein) and the medium rate treatment of the azote fertilizer (100% Mineral N fertilizer + 0% Compost of the recommended dose) led to a significant increase in active substances content such as D-Limonene (%) reached to (51.73% and 52.95%) at the first and second seasons respectively. The interaction between without biofertilization and 50 % Mineral N fertilizer + 50 % Compost treatment led to a significant increase in Trans-β- Ocimene reached to (13.53% and 13.79%) and Carvacrol reached to (17.25% and 17.09%) in two growing seasons respectively. The interaction between Microbein and 0 % Mineral N fertilizer + 100 % Compost treatment gave the highest values of β-Caryophyllene %) reached to (4.25% and 4.45%) during two seasons respectively. The interaction between Microbein and 50 % Mineral N fertilizer + 50 % Compost treatment led to a significant increase in major's chemical composition of essential oils i. e. β-Selinene (%) reached to (7.56 % and 7.80%) and Trans- Sedanolide (%) reached to (17.59% and 19.03%) during two seasons respectively. Using the interaction between without biofertilization and 100 % Mineral N fertilizer + 0 % Compost led to increase in 3-Butylisobenzo- furan 1(3H)-one (%) reached to (8.53% and 8.68%) at the first and second seasons respectively. Inoculation soil by Nitrobein and application of 0 % Mineral N fertilizer + 100 % Compost led to a significant increase in Sedanenolide (%) reached to (18.35% and 18.58%) during two seasons respectively.

The effect of fertilization treatments on the major oil compounds of celery and dill, namely Apiol, Myristien, ß. Pinene, Limonene, andPhellandrene. The results indicated that the use of fertilization treatments had a significant effect on the major's compounds percentage of the studied specialty compounds in celery and dill oil. Apply biofertilizer (CPP) and half dose of NPK; He gave the highest percentage of major's compounds in the first cut of the 2014/2015 season. Similar results were reported by Darzi *et al* (2011) on anisum.

Table 16: Effect of interaction (N bio-fertilizers x Nitrogen rates) on green yield, essential oil conten, essential oil yield and chemical content of celery during two seasons (2020/2019 and 2020/2021).

B x C

Bio-N fertilizers	Nitrogen fertilizer rates	Yield of celery (ton/fed.)			Essential oil content % (V/W)		Essential oil content per plant (ml.)			Essential oil yield (Liter/ fed.)			Chemical content N	P	K
		Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
							First season (2019/2020)								
Without	100 % Mineral N fertilizer	6.470	4.333	10.807	0.043	0.014	0.144	0.030	0.173	2.874	0.595	3.469	2.30	0.36	2.91
	50 % Mineral N fertilizer + 50 % Compost	10.803	8.503	19.307	0.055	0.008	0.303	0.037	0.340	6.058	0.741	6.799	2.47	0.45	2.93
	100 % Compost	7.840	6.080	13.920	0.038	0.008	0.155	0.024	0.180	3.110	0.487	3.596	2.92	0.48	3.22
Microbein	100 % Mineral N fertilizer	10.443	7.953	18.397	0.052	0.014	0.272	0.058	0.329	5.430	1.160	6.590	3.36	0.54	3.16
	50 % Mineral N fertilizer + 50 % Compost	14.613	11.937	26.550	0.062	0.012	0.454	0.070	0.524	9.084	1.396	10.480	2.74	0.44	3.13
	100 % Compost	11.083	10.467	21.550	0.047	0.011	0.263	0.057	0.320	5.257	1.135	6.393	3.36	0.55	3.10
Nitrobein	100 % Mineral N fertilizer	7.787	7.977	15.763	0.060	0.020	0.227	0.092	0.319	4.546	1.834	6.380	3.28	0.45	2.73
	50 % Mineral N fertilizer + 50 % Compost	12.273	9.350	21.623	0.067	0.011	0.411	0.052	0.463	8.220	1.032	9.252	3.01	0.42	2.85
	100 % Compost	12.100	6.533	18.633	0.048	0.011	0.297	0.033	0.329	5.932	0.652	6.584	2.55	0.48	3.22
	L.S.D at 0.05	**0.343**	**0.118**	**0.345**	**N.S.**	**0.001**	**0.026**	**0.005**	**0.024**	**0.518**	**0.096**	**0.485**	**0.03**	**0.01**	**0.01**
							Second season (2020/2021)								
Without	100 % Mineral N fertilizer	6.777	4.577	11.353	0.057	0.016	0.199	0.036	0.235	3.970	0.721	4.691	2.81	0.40	2.68
	50 % Mineral N fertilizer + 50 % Compost	11.177	8.743	19.920	0.067	0.010	0.381	0.047	0.428	7.622	0.938	8.560	2.63	0.49	2.82
	100 % Compost	8.113	6.287	14.400	0.052	0.010	0.215	0.031	0.246	4.301	0.629	4.930	2.90	0.52	3.21
Microbein	100 % Mineral N fertilizer	10.733	8.260	18.993	0.064	0.016	0.344	0.068	0.412	6.871	1.368	8.239	3.39	0.58	3.37
	50 % Mineral N fertilizer + 50 % Compost	15.320	12.277	27.597	0.075	0.014	0.579	0.084	0.663	11.579	1.687	13.266	3.03	0.48	3.09
	100 % Compost	11.323	10.707	22.030	0.059	0.013	0.336	0.069	0.405	6.728	1.375	8.103	3.41	0.59	3.32
Nitrobein	100 % Mineral N fertilizer	8.027	5.747	13.773	0.072	0.022	0.282	0.059	0.341	5.650	1.177	6.827	2.99	0.51	3.04
	50 % Mineral N fertilizer + 50 % Compost	12.280	9.623	21.903	0.080	0.013	0.497	0.063	0.560	9.938	1.255	11.192	2.91	0.48	2.95
	100 % Compost	12.473	9.227	21.700	0.060	0.013	0.381	0.059	0.440	7.614	1.189	8.804	2.63	0.54	3.12
	L.S.D at 0.05	**0.216**	**0.139**	**0.262**	**N.S.**	**0.001**	**0.029**	**0.003**	**0.029**	**0.588**	**0.070**	**0.572**	**0.02**	**0.01**	**0.01**

Table 17: Effect of interaction (N bio-fertilizers x Nitrogen rates) on major components percentage of essential oil content of celery during two seasons (2020/2019 and 2020/2021).

		B x C							
Bio-N fertilizers	**Nitrogen fertilizer rates**	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
		First season (2019/2020)							
Without	**100 % Mineral N fertilizer**	37.81	4.01	2.79	3.18	4.73	8.53	5.78	10.34
	50 % Mineral N fertilizer + 50 % Compost	19.61	13.53	17.25	2.93	2.49	4.30	14.13	14.61
	100 % Compost	44.10	4.44	3.31	3.09	4.58	4.60	13.79	15.14
Microbein	**100 % Mineral N fertilizer**	27.43	3.77	6.90	1.28	1.08	1.36	7.41	3.37
	50 % Mineral N fertilizer + 50 % Compost	25.31	2.95	7.92	3.78	7.56	6.94	15.78	17.59
	100 % Compost	39.28	4.19	1.47	4.25	4.62	4.45	12.62	16.20
Nitrobein	**100 % Mineral N fertilizer**	51.73	6.12	0.93	3.86	5.56	4.34	4.21	6.86
	50 % Mineral N fertilizer + 50 % Compost	38.84	4.82	21.52	2.51	3.05	3.69	9.75	6.60
	100 % Compost	21.05	13.05	13.19	2.39	4.05	5.84	18.35	14.79
	L.S.D at $_{0.05}$	**1.05**	**0.26**	**0.15**	**0.02**	**0.04**	**0.01**	**0.12**	**0.03**
		Second season (2020/2021)							
Without	**100 % Mineral N fertilizer**	38.42	4.55	2.79	3.29	4.96	8.68	6.01	11.68
	50 % Mineral N fertilizer + 50 % Compost	21.14	13.79	17.09	3.15	2.71	4.43	14.36	15.99
	100 % Compost	45.28	4.72	3.31	3.32	4.80	4.73	13.98	16.55
Microbein	**100 % Mineral N fertilizer**	28.86	4.31	6.88	1.51	1.29	0.93	7.64	4.72
	50 % Mineral N fertilizer + 50 % Compost	26.56	3.48	7.94	4.00	7.80	7.08	16.00	19.03
	100 % Compost	40.63	4.69	1.48	4.46	4.84	4.59	12.84	17.55
Nitrobein	**100 % Mineral N fertilizer**	52.95	6.66	0.93	4.08	5.78	4.47	4.43	8.20
	50 % Mineral N fertilizer + 50 % Compost	39.32	5.36	21.60	2.74	3.28	3.83	9.98	7.95
	100 % Compost	22.47	13.66	13.19	2.62	4.27	5.99	18.58	16.16
	L.S.D at $_{0.05}$	**0.67**	**0.16**	**0.08**	**0.03**	**0.02**	**0.02**	**0.11**	**0.11**

F)- Effect of the interaction (Algae extract x Nitrogen fertilizers rates)

I) - Vegetative growth characters

It clear from Table (18) that most of the vegetative growth characteristics of celery plants were significantly affected by the interaction between spraying with algae extract and the rates of nitrogenous fertilizer sources except for the number of main leaves in the second season, which did not reach to the level of significance. The interaction between spraying with algae extract treatment and 50% mineral + 50% compost of the recommended amount where recorded significant differences in most of the characteristics of vegetative growth characteristic, i. e., plant height, number of leaves (major and secondary) and fresh and dry weight of leaves, petioles and whole plant, followed by a treatment without spraying algae among with treatment (50% mineral + 50% compost) and the least interaction coefficients resulting from the overlap between a treatment without spraying algae with mineral fertilization at a rate of (100 % metallic).

II)-Total fresh leaf yield

Table (19) showed that the interaction between spraying algae extracts with organic and mineral nitrogen fertilizers significantly increased leaf yield of celery plant. The interaction between algae extract spraying with the mixed rate of mineral fertilization and organic nitrogen (50% mineral + 50% organic) of the recommended amount resulted in obtaining the highest values of total leaf yield per feddan (24.122 and 24.602 ton/ fed.) compared to other treatments. These increasing reached to 12.080 and 12.024 ton/ fed. at a rate of 50.08 % and 48.87 % in both growing seasons, respectively compared to the interaction between without inoculation biofertilization and 100 % Mineral N fertilizer (control). The reaction was followed by the interaction between without spraying algae extract and 50% mineral + 50% organic from the recommended amount (20.864 and 21,678 ton/ fed.). The lowest yield values were obtained from the interaction between (100% mineral of the recommended amount) without spraying algae extract (12.042 and 12.578 ton/ fed.).

III)- Quality bundles

Table (18) resulted that the interaction between fertilization by spraying with seaweed extract and the levels of nitrogen fertilizer sources significantly increased the quality of leaf yield in celery plants, represented by the average bundle weight and circumference of celery bundles, Table (11). The interaction between the mixed level of mineral and organic nitrogen fertilizer (50% mineral + 50% organic of the recommended amount) and foliar application by algae extract to obtain the highest values for the average weight and circumference of celery bundles, compared to the rest of the interaction coefficients, which recorded lower values. The least treatment was the reaction treatment between the level (100% mineral of the recommended amount) with no spraying of algae extract.

IV)- Essential oil yield

It is clear from Table (19) that the use of the mixed rate between spraying with algae extract and the rates of nitrogen fertilizer sources (50% mineral + 50% organic) resulted in a significant increase in most of the studied characteristics of the content of essential oil in celery plants (percentage - content per plant - The yield of essential oil (liter/ fed.) in the leaves, petioles and whole plan of fresh celery plants, where the highest values were recorded for the yield of essential oil compared to plants not treated with algae spraying and the nitrogen fertilization treatment at a rate of 100% mineral + 0% compost as it reached (11.400 and 13.592 liter/fed.) during the two growing seasons, respectively, the amount of crop increase was 7.601 and 8.649 liter/ fed., i. e. by a percentage of (66.68% and 63.63%) in both planting seasons, respectively.

IIV. Chemical content

The results showed in Table (19) that mixed rate between the algae extract and the high rate of organic manure (0 % Mineral N fertilizer + 100 % Compost of the recommended dose) led to a significant increase in mineral content of N% in leaves of celery plants. The interaction between algae extract spraying and 0 % Mineral N fertilizer + 100 % Compost treatment gave a highest value of P% in leaves of celery plants during the two seasons. the interaction between without algae extract spraying

Table 18: Effect of interaction (Algae extract x Nitrogen rates on vegetative growth of celery during two seasons (2019/2020 and 2020/2021).

A x C

Seaweed extract	Nitrogen fertilizer rates	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
						Leaves	Necks	Total	Leaves	Necks	Total
First season (2019/2020)											
Without	**100 % Mineral N fertilizer**	43.33	19.11	10.11	8.11	353.89	248.22	602.11	48.47	22.65	71.12
	50 % Mineral N fertilizer + 50 % Compost	54.22	22.00	15.89	11.91	576.67	466.56	1043.22	75.30	40.31	115.60
	100 % Compost	47.44	20.89	13.89	9.83	424.44	380.33	804.78	52.61	30.09	82.70
With	**100 % Mineral N fertilizer**	48.00	19.11	13.78	9.96	469.44	427.33	896.78	59.10	31.21	90.31
	50 % Mineral N fertilizer + 50 % Compost	55.67	23.44	16.56	13.19	679.67	526.44	1206.11	90.16	37.14	127.30
	100 % Compost	54.56	22.00	15.00	11.58	609.67	389.00	998.67	80.50	31.31	111.81
	L.S.D at $_{0.05}$	**0.67**	**0.90**	**0.65**	**0.45**	**11.83**	**6.73**	**11.13**	**2.38**	**2.06**	**3.30**
Second season (2020/2021)											
Without	**100 % Mineral N fertilizer**	45.56	19.00	11.11	8.72	368.11	260.78	628.89	49.04	23.70	72.74
	50 % Mineral N fertilizer + 50 % Compost	56.44	23.11	16.89	12.52	606.44	477.44	1083.89	75.89	41.28	117.17
	100 % Compost	49.67	21.89	14.89	10.33	440.89	391.22	832.11	53.18	30.99	84.17
With	**100 % Mineral N fertilizer**	50.33	22.00	15.00	10.46	483.11	358.67	841.78	60.80	25.99	86.79
	50 % Mineral N fertilizer + 50 % Compost	57.67	24.78	17.78	13.69	686.11	544.00	1230.11	90.98	38.39	129.38
	100 % Compost	56.78	23.33	16.00	12.24	622.78	482.78	1105.56	82.21	38.36	120.57
	L.S.D at $_{0.05}$	**0.60**	**N.S.**	**0.53**	**0.34**	**8.51**	**5.68**	**11.57**	**2.42**	**2.03**	**3.10**

Table 19: Effect of interaction (Algae extract x Nitrogen rates) on green yield, essential oil conten, essential oil yield and chemical content of celery during two seasons (2020/2019 and 2020/2021).

A x C

Algae extract	Nitrogen fertilizer rates	Yield of celery (ton/fed.)			Essential oil content					Essential oil yield (Liter/ fed.)			Chemical content		
					% (V/W)		per plant (ml.)						N	P	K
		Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
							First season (2019/2020)								
Without	100 % Mineral N fertilizer	7.078	4.962	12.042	0.046	0.011	0.165	0.025	0.190	3.300	0.499	3.799	2.67	0.43	2.87
	50 % Mineral N fertilizer + 50 % Compost	11.533	9.331	20.864	0.049	0.007	0.283	0.031	0.314	5.659	0.628	6.287	2.56	0.40	2.66
	100 % Compost	8.489	7.607	16.096	0.039	0.007	0.169	0.028	0.197	3.382	0.560	3.942	2.77	0.47	3.28
With	100 % Mineral N fertilizer	9.389	8.547	17.936	0.058	0.021	0.263	0.095	0.358	5.266	1.894	7.161	3.28	0.46	3.00
	50 % Mineral N fertilizer + 50 % Compost	13.593	10.529	24.122	0.073	0.014	0.496	0.074	0.570	9.915	1.484	11.400	2.91	0.47	3.28
	100 % Compost	12.193	7.780	19.973	0.050	0.012	0.308	0.048	0.355	6.151	0.956	7.107	3.11	0.53	3.07
L.S.D at 0.05		0.237	0.118	0.223	0.004	0.001	0.025	0.004	N.S.	0.496	0.073	N.S.	0.02	0.01	0.02
							Second season (2020/2021)								
Without	100 % Mineral N fertilizer	7.362	5.216	12.578	0.058	0.013	0.216	0.032	0.247	4.311	0.631	4.943	2.77	0.47	2.91
	50 % Mineral N fertilizer + 50 % Compost	12.129	9.549	21.678	0.062	0.009	0.379	0.042	0.421	7.586	0.834	8.420	2.66	0.44	2.70
	100 % Compost	8.818	7.824	16.642	0.052	0.009	0.233	0.037	0.269	4.650	0.732	5.382	2.85	0.51	3.32
With	100 % Mineral N fertilizer	9.662	7.173	16.836	0.071	0.023	0.334	0.077	0.411	6.682	1.546	8.228	3.35	0.52	3.15
	50 % Mineral N fertilizer + 50 % Compost	13.722	10.880	24.602	0.086	0.016	0.592	0.088	0.680	11.840	1.752	13.592	3.05	0.52	3.21
	100 % Compost	12.456	9.656	22.111	0.062	0.014	0.389	0.070	0.459	7.779	1.397	9.175	3.11	0.59	3.11
L.S.D at 0.05		0.170	0.114	0.231	0.005	0.001	N.S.	0.002	N.S.	N.S.	0.040	N.S.	0.03	0.01	0.02

treatment and 0 % Mineral N fertilizer + 100 % Compost gave the highest values of K% in leaves. The results were similar in the two seasons. The combination of different N sources and foliar spraying of alga extract resulted in further significant increases in plant uptake of NPK which in turn significantly improved the above growth parameters and production components of broccoli plants (Shams and Nahla Morsy, 2019).

IIIV. Active substances content (Major components percentage of essential oil):

It is clear from Table (20) that the use of the mixed rate between algae extract spraying and 100% Mineral N fertilizer + 0% Compost of the recommended dose led to a significant increase in active substances content such as D-Limonene (%) reached to (51.37% and 52.52%) at the first and second seasons respectively. The interaction between without algae extract spraying and 0 % Mineral N fertilizer + 100 % Compost treatment led to a significant increase in Carvacrol (%) reached to (15.79% and 15.70%) in the two growing seasons respectively. The interaction between without algae extract spraying and 0 % Mineral N fertilizer + 100 % Compost treatment gave the highest values of Trans-β-Ocimene (%) reached to (11.81% and 12.21%) and β-Caryophyllene (%) reached to (4.08% and 4.30%) during two seasons respectively. The interaction between algae extract spraying and 50 % Mineral N fertilizer + 50 % Compost treatment led to a significant increase in major's chemical composition of essential oils i. e. β-Selinene (%) reached to (5.95 % and 6.17%) during two seasons respectively. Using the interaction between with spraying algae extract and 0 % Mineral N fertilizer + 100 % Compost led to increase in 3-Butylisobenzo- furan 1(3H)-one (%) reached to (5.88% and 6.02%); Sedanenolide (%) reached to (19.56% and 19.76%) and Trans- Sedanolide (%) reached to (21.54% and 22.92%) during two seasons respectively.

G)- Effect of the interaction (Algae extract x Bio-nitrogen fertilization x Nitrogen fertilizers rates)

I) - Vegetative growth characters

Data showed in Tables (21 & 22) reported that most of the vegetative growth characteristics of celery plants were significantly affected by the interaction between spraying seaweed extract, bio-nitrogen fertilization and nitrogen fertilizers rates, where the interaction recorded significant differences in each of plant length, main leaf number per plant, head circulenes and fresh and dry weight of leaves, petioles and whole plant. The application of spraying algae extract with the inoculant of Microbein as a bio-fertilizer and application of 50 % Mineral N fertilizer + 50 % Compost recorded the highest values of vegetative growth characteristics of celery plants with significant differences with in most of the traits except for the number of main leaves at the second season and side leaf number during two seasons without significant differences and followed by spraying seaweed extract + Microbein inoculate + 100 % Compost treatment compared to control (Without algae extract + non- inoculation + 100 % Mineral N fertilizer).

II)-Total fresh leaf yield

It is clear from Tables (23 & 24) that the interaction between algae extract, bio-nitrogen fertilization and nitrogen fertilizers rates resulted in a significant increase in leaf yield of celery plants. The interaction between spraying algae extracts, Microbein inoculated and 50 % Mineral N fertilizer + 50 % Compost resulted in the highest values of total leaf yield per feddan (27.293 and 28.107 ton/ fed.) at the first and second season, respectively compared to other interaction treatments follow up the interaction between without spraying algae extracts, Microbein inoculated and 50 % Mineral N fertilizer + 50 % Compost came in the second order. The lowest leaf yield values were obtained from the interaction between not sprayed with algae extract and without bio-fertilization treatment and application of 100 % Mineral N fertilizer.

III)- Quality bundles

It is clear from Tables (21 & 22) that interaction between spraying with algae extract spraying, Microbein as a bio-fertilizer and 50 % Mineral N fertilizer + 50 % Compost resulted in a significant increase and obtaining the highest values for the average weight and head circumference of celery plant, compared to the rest of the interaction treatments, which recorded lower values represented in a physical quality of celery bundles.

Table 20: Effect of interaction (Algae extract x Nitrogen rates on major components percentage of essential oil content of celery during two seasons (2019/2020 and 2020/2021).

		A x C							
Algae extract	**Nitrogen fertilizer rates**	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
		First season (2019/2020)							
Without	**100 % Mineral N fertilizer**	51.37	6.66	1.36	2.20	2.39	6.67	6.33	7.57
	50 % Mineral N fertilizer + 50 % Compost	32.43	11.47	15.79	2.50	2.79	5.37	14.05	11.97
	100 % Compost	46.09	11.81	5.47	4.08	4.96	4.04	10.28	9.20
With	**100 % Mineral N fertilizer**	26.61	2.61	5.72	3.35	5.19	2.82	5.27	6.13
	50 % Mineral N fertilizer + 50 % Compost	23.41	2.73	15.33	3.64	5.95	4.59	12.39	13.90
	100 % Compost	23.53	2.65	6.51	2.41	3.87	5.88	19.56	21.54
L.S.D at $_{0.05}$		**0.63**	**0.21**	**0.06**	**0.01**	**0.03**	**0.01**	**0.08**	**0.03**
		Second season (2020/2021)							
Without	**100 % Mineral N fertilizer**	52.52	7.19	1.35	2.36	2.60	6.80	6.55	8.92
	50 % Mineral N fertilizer + 50 % Compost	33.64	11.79	15.70	2.72	3.02	5.50	14.27	13.31
	100 % Compost	47.53	12.21	5.47	4.30	5.19	4.18	10.51	10.58
With	**100 % Mineral N fertilizer**	27.64	3.15	5.72	3.57	5.41	2.58	5.50	7.47
	50 % Mineral N fertilizer + 50 % Compost	24.37	3.29	15.38	3.87	6.17	4.72	12.63	15.33
	100 % Compost	24.73	3.17	6.51	2.63	4.08	6.02	19.76	22.92
	L.S.D at $_{0.05}$	**0.48**	**0.23**	**0.06**	**0.03**	**0.02**	**0.04**	**0.10**	**0.06**

Table 21: Effect of interaction (Sea weeds x N-bio-fertilizers x Nitrogen rates) on vegetative growth of celery at the first season (2019/2020).

A x B x C

Algae extract	Bio-N fertilizers	Nitrogen fertilizer rates	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
							Leaves	Necks	Total	Leaves	Necks	Total
			First season (2019/2020)									
Without	**Without**	**100 % Mineral N fertilizer**	35.33	19.00	8.00	6.50	215.00	103.33	318.33	23.38	7.93	31.31
		50 % Mineral N fertilizer + 50 % Compost	47.67	22.00	15.67	10.50	512.33	376.67	889.00	59.13	30.53	89.66
		100 % Compost	41.67	20.67	12.00	8.83	330.00	242.33	572.33	37.13	19.38	56.51
	Microbein	**100 % Mineral N fertilizer**	47.67	20.33	8.33	8.00	408.33	331.67	740.00	66.03	28.26	94.29
		50 % Mineral N fertilizer + 50 % Compost	59.00	22.00	14.00	13.57	697.33	593.00	1290.33	73.92	46.56	120.48
		100 % Compost	50.00	20.67	13.67	10.83	429.67	488.00	917.67	68.69	36.95	105.64
	Nitrobein	**100 % Mineral N fertilizer**	47.00	18.00	14.00	9.83	438.33	309.67	748.00	56.02	31.75	87.77
		50 % Mineral N fertilizer + 50 % Compost	56.00	22.00	18.00	11.67	520.33	430.00	950.33	92.84	43.83	136.67
		100 % Compost	50.67	21.33	16.00	9.83	513.67	410.67	924.33	52.01	33.95	85.95
With	**Without**	**100 % Mineral N fertilizer**	48.00	15.67	9.67	9.87	432.00	330.33	762.33	52.04	22.73	74.77
		50 % Mineral N fertilizer + 50 % Compost	54.00	24.00	14.33	10.83	568.00	473.67	1041.67	62.97	34.69	97.66
		100 % Compost	52.33	22.00	11.33	10.47	454.00	365.67	819.67	55.17	30.34	85.52
	Microbein	**100 % Mineral N fertilizer**	51.33	22.00	16.33	11.83	636.00	463.67	1099.67	83.93	34.06	117.99
		50 % Mineral N fertilizer + 50 % Compost	56.33	24.67	18.33	15.40	764.00	600.67	1364.67	115.35	39.88	155.23
		100 % Compost	56.33	22.67	17.67	12.60	678.67	558.67	1237.33	97.62	45.51	143.13
	Nitrobein	**100 % Mineral N fertilizer**	44.67	19.67	15.33	8.17	340.33	488.00	828.33	41.35	36.82	78.17
		50 % Mineral N fertilizer + 50 % Compost	56.67	21.67	17.00	13.33	707.00	505.00	1212.00	92.16	36.84	129.00
		100 % Compost	55.00	21.33	16.00	11.67	696.33	242.67	939.00	88.70	18.07	106.77
		L.S.D at $_{0.05}$	**2.22**	**1.79**	**N.S.**	**0.85**	**24.27**	**9.53**	**24.37**	**4.70**	**4.74**	**6.76**

Table 22: Effect of interaction (Sea weeds x N-bio-fertilizers x Nitrogen rates) on vegetative growth of celery at the second season (2020/2021).

A x B x C

Algae extract	Bio-N fertilizers	Nitrogen fertilizer rates	Plant length (cm)	Main leaf No./ plant	Side leaf No./ plant	Head circulenes (cm)	Fresh weight (g / plant)			Dry weight (g / plant)		
							Leaves	Necks	Total	Leaves	Necks	Total
			Second season (2020/2021)									
Without	Without	100 % Mineral N fertilizer	37.33	16.67	9.00	7.17	230.33	115.33	345.67	25.06	8.80	33.86
		50 % Mineral N fertilizer + 50 % Compost	49.67	23.00	16.67	11.17	527.67	385.33	913.00	60.91	31.28	92.19
		100 % Compost	44.33	21.67	13.00	9.33	345.33	251.00	596.33	38.85	20.15	59.00
	Microbein	100 % Mineral N fertilizer	49.67	21.33	9.33	8.67	423.67	347.00	770.67	66.03	29.55	95.58
		50 % Mineral N fertilizer + 50 % Compost	61.67	23.33	15.00	14.07	749.33	605.00	1354.33	73.92	47.50	121.42
		100 % Compost	52.00	21.67	14.67	11.33	441.67	500.00	941.67	68.69	37.87	106.57
	Nitrobein	100 % Mineral N fertilizer	49.67	19.00	15.00	10.33	450.33	320.00	770.33	56.02	32.76	88.78
		50 % Mineral N fertilizer + 50 % Compost	58.00	23.00	19.00	12.33	542.33	442.00	984.33	92.84	45.06	137.89
		100 % Compost	52.67	22.33	17.00	10.33	535.67	422.67	958.33	52.01	34.94	86.94
With Bio-	Without	100 % Mineral N fertilizer	50.00	20.67	10.67	10.37	447.33	342.33	789.67	53.87	23.56	77.42
		50 % Mineral N fertilizer + 50 % Compost	56.00	25.00	15.33	11.33	590.00	489.00	1079.00	65.43	35.81	101.24
		100 % Compost	55.00	23.00	12.33	10.97	466.00	377.67	843.67	56.63	31.34	87.97
	Microbein	100 % Mineral N fertilizer	54.33	23.00	17.33	12.33	649.67	479.00	1128.67	85.73	35.18	120.91
		50 % Mineral N fertilizer + 50 % Compost	58.33	25.67	20.00	15.90	782.67	622.67	1405.33	118.15	41.37	159.51
		100 % Compost	58.33	23.67	18.67	13.43	690.67	570.67	1261.33	99.35	46.49	145.84
	Nitrobein	100 % Mineral N fertilizer	46.67	22.33	17.00	8.67	352.33	254.67	607.00	42.80	19.25	62.05
		50 % Mineral N fertilizer + 50 % Compost	58.67	23.67	18.00	13.83	685.67	520.33	1206.00	89.37	38.00	127.37
		100 % Compost	57.00	23.33	17.00	12.33	711.67	500.00	1211.67	90.66	37.25	127.91
		L.S.D at $_{0.05}$	**1.60**	**N.S.**	**N.S.**	**0.66**	**15.30**	**9.82**	**18.53**	**4.13**	**4.86**	**5.85**

IV)- Essential oil yield

It is clear from Tables (23 & 24) that the use of the interaction between spraying with algae extract, bio-nitrogen fertilization (Microbein) and application of 50 % Mineral N fertilizer + 50 % Compost resulted in a significant increase in the essential oil content, i. e. % (V/W), per plant (ml.) and per liter/ fed. in leaves, petioles and whole plant of celery. The highest values of oil yield (compared to untreated plants) were recorded (13,203 and 13.300 liters / feddan) during two growing seasons, respectively reached to 11.174 and 10.515 ton/ fed. at a rate of (84.63 % and 79.06 %) compared to the least values (Without algae extract x without biofertilizer x 100 % Mineral N fertilizer) in both growing seasons, respectively. The interaction between spraying with algae extract and bio-nitrogen fertilization (Nitrobein) and fertilization by 50 % Mineral N fertilizer + 50 % Compost came in the second order.

IIV. Chemical content

It is clear from (23 & 24) that the interaction between spraying with algae extract, Microbein as a bio-fertilizer and application of 100 % Compost resulted a significant difference and gave a highest value of N% and P% in leaves of celery plants compared to other interactions. The lowest values of mineral content, i. e. N% and P% were recorded by the interaction of without spraying by algae extract and without bio-fertilization and fertilization 100 % Mineral N fertilizer treatment. The results were similar in two growing seasons.

IIIV. Active substances content (Major components percentage of essential oil)

Data presented in Tables (24 & 25) show that the effect of the interaction between spraying with algae extract, bio-nitrogen fertilization and application of nitrogen sources rates on the major components percentage of essential oil in leaves of celery plants. The interaction between without algae extract spraying, without nitrogen bio-fertilization and 100% compost led to a significant difference in the major component's percentage in essential oil of celery plants such as D-Limonene (5) reached to (66.65% and 67.60%) at the first and second season respectively. Trans-β- Ocimene (%) recorded a highest value (25.48% and 25.40%) during two seasons respectively when celery plants did not spray with algae extract and did not inoculate by biofertilizer and fertilized by 50 % Mineral N fertilizer + 50 % Compost compared to other interactions. The interaction between algae extract spraying, Nitrobein as a biofertilizer and 50% Mineral N fertilizer + 50% Compost treatment recorded the highest values of Carvacrol (%) reached to (33.75% and 33.85%) in essential oil content of celery plants during two growing seasons respectively. Spraying of celery plants by algae extract and did not inoculate by biofertilizer and fertilized by the rate of 100 % Mineral N fertilizer recorded the higher major components percentage in essential oil content such as β-Caryophyllene (%) reached to (6.36% and 6.58%) during two seasons respectively. β-Selinene recorded the highest values (12.35% and 12.56%) when celery plants sprayed with algae extract and inoculated by Microbein as a biofertilizer and fertilized by the rate of 50 % Mineral N fertilizer + 50 % Compost.

3-Butylisobenzo- furan 1(3H)-one recorded a highest value (14.40% and 14.55%) during two seasons respectively when celery plants were not spray with algae extract and did not inoculate by any biofertilizers but it was application of 100 % Mineral N fertilizer. Also, Sedanenolide recorded a highest value (25.00% and 25.21%) during two seasons when celery plants were sprayed with algae extract and inoculated by Nitrobein and fertilized by the rate of 100 % Compost. Trans-Sedanenolide recorded a highest value (25.24% and 24.71%) during two seasons when celery plants were sprayed with algae extract and uninoculated and fertilized by the rate of 100 % Compost.

Table 23: Effect of interaction (Sea weeds xN-bio-fertilizers x Nitrogen rates) on green yield, essential oil conten, essential oil yield and chemical content

A x B x C

Algae extract	Bio-N fertilizers	Nitrogen fertilizer rates	Yield of celery (ton/fed.)			Essential oil content					Essential oil yield (Liter/ fed.)			Chemical content		
						% (V/W)		per plant (ml.)						N	P	K
			Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
								First season (2019/2020)								
Without	Without	100 % Mineral N fertilizer	4.300	2.060	6.367	0.040	0.015	0.086	0.016	0.102	1.720	0.309	2.029	1.84	0.37	3.05
		50 % Mineral N fertilizer + 50 % Compost	10.247	7.533	17.780	0.033	0.005	0.171	0.019	0.190	3.415	0.377	3.792	2.37	0.35	2.82
		100 % Compost	6.600	4.847	11.447	0.030	0.005	0.099	0.012	0.111	1.979	0.242	2.222	3.10	0.44	3.43
	Microbein	100 % Mineral N fertilizer	8.167	6.633	14.800	0.050	0.012	0.204	0.039	0.243	4.081	0.774	4.855	3.08	0.53	3.05
		50 % Mineral N fertilizer + 50 % Compost	13.947	11.860	25.807	0.050	0.007	0.348	0.040	0.388	6.966	0.791	7.757	2.56	0.40	2.64
		100 % Compost	8.593	9.760	18.353	0.043	0.008	0.186	0.039	0.225	3.728	0.781	4.509	3.03	0.50	3.08
	Nitrobein	100 % Mineral N fertilizer	8.767	6.193	14.960	0.047	0.007	0.205	0.021	0.226	4.099	0.413	4.511	3.09	0.40	2.51
		50 % Mineral N fertilizer + 50 % Compost	10.407	8.600	19.007	0.063	0.008	0.330	0.036	0.366	6.597	0.717	7.314	2.74	0.45	2.52
		100 % Compost	10.273	8.213	18.487	0.043	0.008	0.222	0.033	0.255	4.437	0.657	5.094	2.19	0.48	3.34
With	Without	100 % Mineral N fertilizer	8.640	6.607	15.247	0.047	0.013	0.201	0.044	0.245	4.028	0.881	4.909	2.76	0.35	2.77
		50 % Mineral N fertilizer + 50 % Compost	11.360	9.473	20.833	0.077	0.012	0.435	0.055	0.490	8.701	1.105	9.806	2.56	0.54	3.04
		100 % Compost	9.080	7.313	16.393	0.047	0.010	0.212	0.037	0.249	4.240	0.731	4.971	2.73	0.52	3.00
	Microbein	100 % Mineral N fertilizer	12.720	9.273	21.993	0.053	0.017	0.339	0.077	0.416	6.779	1.545	8.324	3.64	0.54	3.27
		50 % Mineral N fertilizer + 50 % Compost	15.280	12.013	27.293	0.073	0.017	0.560	0.100	0.660	11.201	2.002	13.203	2.91	0.47	3.61
		100 % Compost	13.573	11.173	24.747	0.050	0.013	0.339	0.075	0.414	6.787	1.490	8.277	3.70	0.60	3.13
	Nitrobein	100 % Mineral N fertilizer	6.807	9.760	16.567	0.073	0.033	0.250	0.163	0.412	4.993	3.256	8.249	3.46	0.50	2.95
		50 % Mineral N fertilizer + 50 % Compost	14.140	10.100	24.240	0.070	0.013	0.492	0.067	0.560	9.844	1.346	11.190	3.28	0.40	3.18
		100 % Compost	13.927	4.853	18.780	0.053	0.013	0.371	0.032	0.404	7.426	0.647	8.073	2.91	0.47	3.09
		L.S.D at $_{0.05}$	**0.485**	**0.167**	**0.487**	**0.008**	**0.001**	**0.037**	**0.007**	**0.034**	**0.733**	**0.135**	**0.685**	**0.04**	**0.02**	**0.02**

Table 24: Effect of interaction (Sea weeds xN-bio-fertilizers x Nitrogen rates) on green yield, essential oil conten, essential oil yield and chemical content

A x B x C																
Algae extract	Bio-N fertilizers	Nitrogen fertilizer rates	Yield of celery (ton/fed.)			Essential oil content % (V/W)		Essential oil content per plant (ml.)			Essential oil yield (Liter/ fed.)			Chemical content N	P	K
			Leaves	Necks	Total	Leaves	Necks	Leaves	Necks	Total	Leaves	Necks	Total	(%)	(%)	(%)
								Second season (2020/2021)								
Without	Without	100 % Mineral N fertilizer	4.607	2.307	6.913	0.052	0.017	0.120	0.020	0.139	2.393	0.392	2.785	1.90	0.41	2.55
		50 % Mineral N fertilizer + 50 % Compost	10.553	7.707	18.260	0.045	0.007	0.239	0.027	0.266	4.784	0.539	5.323	2.45	0.39	2.56
		100 % Compost	6.907	5.020	11.927	0.045	0.007	0.157	0.018	0.174	3.131	0.351	3.483	3.18	0.48	3.38
	Microbein	100 % Mineral N fertilizer	8.473	6.940	15.413	0.062	0.014	0.263	0.047	0.310	5.256	0.948	6.204	3.24	0.57	3.09
		50 % Mineral N fertilizer + 50 % Compost	14.987	12.100	27.087	0.065	0.009	0.490	0.052	0.543	9.802	1.049	10.851	2.70	0.44	2.86
		100 % Compost	8.833	10.000	18.833	0.055	0.010	0.245	0.050	0.295	4.892	1.000	5.892	3.10	0.54	3.47
	Nitrobein	100 % Mineral N fertilizer	9.007	6.400	15.407	0.059	0.009	0.264	0.028	0.292	5.285	0.554	5.839	3.17	0.44	3.09
		50 % Mineral N fertilizer + 50 % Compost	10.847	8.840	19.687	0.075	0.010	0.409	0.046	0.454	8.171	0.914	9.085	2.82	0.49	2.68
		100 % Compost	10.713	8.453	19.167	0.055	0.010	0.296	0.042	0.339	5.927	0.845	6.772	2.27	0.52	3.12
With Bio-	Without	100 % Mineral N fertilizer	8.947	6.847	15.793	0.062	0.015	0.277	0.053	0.330	5.547	1.050	6.597	3.72	0.39	2.81
		50 % Mineral N fertilizer + 50 % Compost	11.800	9.780	21.580	0.089	0.014	0.523	0.067	0.590	10.461	1.336	11.797	2.81	0.58	3.08
		100 % Compost	9.320	7.553	16.873	0.059	0.012	0.274	0.045	0.319	5.470	0.906	6.377	2.62	0.56	3.04
	Microbein	100 % Mineral N fertilizer	12.993	9.580	22.573	0.065	0.019	0.424	0.089	0.514	8.486	1.787	10.273	3.54	0.58	3.65
		50 % Mineral N fertilizer + 50 % Compost	15.653	12.453	28.107	0.085	0.019	0.668	0.116	0.784	13.356	2.325	15.680	3.36	0.51	3.31
		100 % Compost	13.813	11.413	25.227	0.062	0.015	0.428	0.088	0.516	8.564	1.750	10.315	3.73	0.64	3.17
	Nitrobein	100 % Mineral N fertilizer	7.047	5.093	12.140	0.085	0.035	0.301	0.090	0.391	6.014	1.800	7.814	2.81	0.58	2.99
		50 % Mineral N fertilizer + 50 % Compost	13.713	10.407	24.120	0.085	0.015	0.585	0.080	0.665	11.704	1.596	13.300	2.99	0.48	3.22
		100 % Compost	14.233	10.000	24.233	0.065	0.015	0.465	0.077	0.542	9.302	1.533	10.835	2.99	0.55	3.13
		L.S.D at $_{0.05}$	**0.306**	**0.196**	**0.371**	**0.008**	**0.001**	**0.042**	**0.005**	**0.040**	**0.832**	**0.099**	**0.809**	**0.03**	**0.02**	**0.02**

Table 25: Effect of interaction (Sea weeds xN-bio-fertilizers x Nitrogen rates) on major components percentage of essential oil content of celery at the first season (2019/2020).

			A x B x C							
Algae extract	**Bio-N fertilizers**	**Nitrogen fertilizer rates**	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
			First season (2019/2020)							
Without	**Without**	**100 % Mineral N fertilizer**	55.24	4.83	0.00	0.00	1.90	14.40	1.23	14.13
		50 % Mineral N fertilizer + 50 % Compost	25.18	25.48	25.36	2.11	2.28	4.16	14.13	10.30
		100 % Compost	66.65	6.46	0.00	3.15	3.03	3.41	7.63	7.04
	Microbein	**100 % Mineral N fertilizer**	37.62	5.03	4.07	1.63	1.14	2.72	11.20	5.53
		50 % Mineral N fertilizer + 50 % Compost	29.71	3.79	12.72	2.36	2.77	6.13	16.68	17.12
		100 % Compost	47.58	5.25	0.00	5.72	6.09	4.93	11.50	13.65
	Nitrobein	**100 % Mineral N fertilizer**	61.24	10.12	0.00	4.96	4.12	2.87	6.57	3.05
		50 % Mineral N fertilizer + 50 % Compost	42.39	5.13	9.29	3.03	3.30	5.81	11.33	8.47
		100 % Compost	24.04	23.71	16.42	3.37	5.77	3.77	11.70	6.92
With	**Without**	**100 % Mineral N fertilizer**	20.38	3.20	5.57	6.36	7.57	2.66	10.33	6.54
		50 % Mineral N fertilizer + 50 % Compost	14.04	1.58	9.13	3.75	2.70	4.45	14.12	18.92
		100 % Compost	21.55	2.42	6.62	3.03	6.13	5.78	19.94	23.24
	Microbein	**100 % Mineral N fertilizer**	17.24	2.52	9.72	0.93	1.01	0.00	3.63	1.20
		50 % Mineral N fertilizer + 50 % Compost	20.91	2.10	3.12	5.20	12.35	7.75	14.87	18.06
		100 % Compost	30.98	3.13	2.95	2.78	3.15	3.97	13.74	18.74
	Nitrobein	**100 % Mineral N fertilizer**	42.22	2.13	1.86	2.75	6.99	5.80	1.85	10.66
		50 % Mineral N fertilizer + 50 % Compost	35.29	4.51	33.75	1.98	2.80	1.57	8.18	4.73
		100 % Compost	18.07	2.39	9.96	1.42	2.32	7.90	25.00	22.65
		L.S.D at $_{0.05}$	**1.48**	**0.36**	**0.21**	**0.03**	**0.05**	**0.01**	**0.17**	**0.04**

Table 26: Effect of interaction (Sea weeds xN-bio-fertilizers x Nitrogen rates) on major components percentage of essential oil content of celery at the second season (2020/2021).

A x B x C										
Algae extract	**Bio-N fertilizers**	**Nitrogen fertilizer rates**	**D-Limonene**	**Trans-β-Ocimene**	**Carvacrol**	**β-Caryophyllene**	**β-Selinene**	**3-Butylisobenzo-furan 1(3H)-one**	**Sedanenolide**	**Trans-Sedanolide**
			Second season (2020/2021)							
Without	**Without**	**100 % Mineral N fertilizer**	55.85	5.36	0.00	0.00	2.11	14.55	1.44	15.48
		50 % Mineral N fertilizer + 50 % Compost	26.82	25.40	25.02	2.32	2.49	4.29	14.34	11.65
		100 % Compost	67.60	6.49	0.00	3.36	3.26	3.53	7.86	8.38
	Microbein	**100 % Mineral N fertilizer**	39.04	5.56	4.04	1.86	1.35	2.86	11.43	6.88
		50 % Mineral N fertilizer + 50 % Compost	31.36	4.32	12.72	2.57	3.04	6.27	16.91	18.47
		100 % Compost	49.53	5.75	0.00	5.95	6.31	5.09	11.72	15.02
	Nitrobein	**100 % Mineral N fertilizer**	62.66	10.65	0.00	5.21	4.34	2.99	6.78	4.40
		50 % Mineral N fertilizer + 50 % Compost	42.74	5.66	9.36	3.28	3.53	5.95	11.55	9.82
		100 % Compost	25.46	24.40	16.42	3.59	6.00	3.92	11.94	8.33
With Bio-	**Without**	**100 % Mineral N fertilizer**	20.99	3.73	5.57	6.58	7.80	2.80	10.58	7.87
		50 % Mineral N fertilizer + 50 % Compost	15.46	2.18	9.15	3.97	2.92	4.58	14.39	20.33
		100 % Compost	22.97	2.96	6.62	3.28	6.35	5.92	20.10	24.71
	Microbein	**100 % Mineral N fertilizer**	18.68	3.05	9.72	1.16	1.23	-1.00	3.84	2.55
		50 % Mineral N fertilizer + 50 % Compost	21.76	2.64	3.15	5.42	12.56	7.88	15.09	19.59
		100 % Compost	31.73	3.63	2.96	2.97	3.36	4.10	13.96	20.07
	Nitrobein	**100 % Mineral N fertilizer**	43.24	2.66	1.86	2.96	7.22	5.94	2.07	11.99
		50 % Mineral N fertilizer + 50 % Compost	35.90	5.06	33.85	2.20	3.04	1.70	8.41	6.07
		100 % Compost	19.49	2.92	9.96	1.65	2.54	8.05	25.21	23.99
		L.S.D at $_{0.05}$	**0.95**	**0.23**	**0.11**	**0.04**	**0.03**	**0.03**	**0.16**	**0.16**

Table 27: Effect of algae extract, bio- nitrogen fertilizers and Nitrogen fertilizer rates (Mineral +Organic) and their interactions on mean values of compounds content in leaves of celery plants.

No.	Compounds	Rt	Without algae extract									With algae extract								
			Without			Microbein			Nitrobein			Without			Microbein			Nitrobein		
			N1	N2	N3	N1	N2	N3	N1	N2	N3	N1	N2	N3	N1	N2	N3	N1	N2	N3
1	Sabinene	7.315	-	-	-	4.36	-	-	-	-	-	-	0.45	-	9.19	-	-	-	-	-
2	β-Pinene	7.408	1.10	-	-	-	0.67	-	3.38	1.57	2.13	0.94	-	-	0.66	-	-	-	1.57	-
3	β-Myrcene	7.722	-	0.74	-	0.91	-	-	-	0.68	0.71	-	-	-	0.99	-	-	-	-	-
4	p-Cymene	8.632	1.06	-	-	-	-	-	-	1.70	2.05	-	-	-	-	-	-	1.78	1.88	-
5	D-Limonene	8.752	54.41	25.13	66.15	37.62	29.74	47.74	61.23	42.38	23.62	20.14	13.82	21.15	17.21	20.43	30.35	42.37	35.37	17.90
6	trans-β-Ocimene	8.963	4.84	2.78	6.29	4.98	3.78	5.21	10.14	5.09	4.68	3.14	1.54	2.42	2.51	2.12	3.11	2.12	4.52	2.37
7	γ-Terpinene	9.570	1.20	0.69	1.50	1.94	0.95	1.92	3.72	1.61	1.63	1.56	-	0.97	2.25	-	-	-	1.29	0.69
8	Citronellal	12.179	-	-	-	4.57	-	-	-	-	-	-	1.50	-	3.56	-	-	-	-	-
9	Terpinen-4-ol	12.906	-	-	1.91	9.31	-	-	-	-	0.48	-	7.92	-	22.32	-	-	-	-	-
10	Citronellol	14.250	-	-	-	4.24	-	-	-	-	0.96	-	3.12	-	7.04	-	-	-	-	-
11	Neral	14.640	-	2.44	-	-	1.28	-	-	1.16	2.37	1.23	0.76	1.00	1.68	-	-	-	-	-
12	α-Citral	15.435	-	3.35	-	-	1.82	-	-	1.58	3.20	1.79	1.38	1.48	2.48	-	-	-	-	0.67
13	Carvacrol	16.270	-	25.07	-	4.05	12.67	-	-	9.33	16.45	5.57	9.11	6.62	9.70	3.10	2.93	1.84	33.74	9.92
14	(E)-Methyl cinnamate	18.451	-	2.60	-	-	1.87	-	-	1.85	2.68	2.11	1.69	2.44	1.55	1.39	-	-	-	0.92
15	β-Caryophyllene	19.452	-	2.10	3.14	1.63	2.36	5.72	4.97	3.03	3.36	6.36	3.74	3.02	0.93	5.20	2.78	2.74	1.95	1.40
16	β-Selinene	21.123	1.88	2.27	3.03	1.12	2.85	6.08	4.11	3.29	5.77	7.57	2.69	6.12	0.99	12.33	3.14	6.96	2.78	2.30
17	Caryophyllene oxide	23.462	-	-	-	-	-	1.30	-	1.18	0.60	0.88	-	-	-	3.27	-	2.55	-	-
18	3-Butylisobenzofuran-1(3H)-one	24.985	14.39	4.15	3.39	2.71	6.12	4.92	2.87	5.79	3.76	2.66	4.44	5.77	-	7.74	3.95	5.79	1.56	7.89
19	Sedanenolide	26.507	1.21	14.11	7.61	11.18	16.67	13.47	6.55	11.31	11.69	10.31	14.10	19.70	3.61	14.84	13.71	1.84	8.16	24.5
20	trans-Sedanolide	26.633	14.13	10.29	7.00	5.53	17.10	13.64	3.03	8.45	6.90	6.54	18.9	23.22	1.18	18.04	18.72	10.51	4.70	22.63
21	trans-Ligustilide	26.832	-	-	-	-	0.76	-	-	-	0.89	-	1.22	1.21	-	-	-	-	-	1.53
22	Falcarinol	31.954	-	-	-	-	0.46	-	-	-	0.29	2.06	-	-	-	1.30	-	-	-	0.45
	Nitrogen fertilizer rates	Mean	10.47	7.36	11.11	6.73	6.61	11.11	11.11	6.25	4.71	4.86	3.93	7.32	5.17	4.08	9.84	7.85	8.87	7.17
	Bio-Nitrogen fertilizers	Mean		9.65			8.15			7.36			5.37			6.36			7.96	
	Algae extract	Mean					8.38									6.56				

N1: 100 % Mineral N fertilizer + 0 % Compost. = 7.70
N2: 50 % Mineral N fertilizer + 50 % Compost. = 6.18
N2: 0 % Mineral N fertilizer + 100 % Compost. = 8.54

References

Abdel-Mawgoud, A.M.R., A.S. Tantawy, Magda M. Hafez and Hoda A. M. Habib, 2010. Seaweed extract improves growth, yield and quality of different watermelon hybrids Research Journal of Agriculture and Biological Sciences, 6(2): 161–186.

Abo Sedera, F.A., Amany A. Abd El-Latif., L.A.A. Bader and S.M. Rezk, 2010. Effect of NPK mineral fertilizer levels and foliar application with humic and amino acids on yield and quality of strawberry. Egypt. J. of Appl. Sci., 25:154-169

Abo-Basha, D.M.R., Afify, R.R.M. and H.H. Abdel-Kader, 2019. Response of spinach (*Spinacia olerasea* L.) to algae extract under different nitrogen rates. Middle East Journal of Agriculture Research, 8 (1): 47-55.

Abo-Basha, D.M.R., Afify, R.R.M. and H.H. Abdel-Kader, 2019. Response of spinach (*Spinacia olerasea* L.) to algae extract under different nitrogen rates. Middle East Journal of Agriculture Research, 8 (1): 47-55.

Abou- El- Magd, M.M., M.F. Zaki and S.D. Abou Hussein, 2008. Effect of organic manure and different levels of saline irrigation water on growth, green yield and chemical content of sweet fennel. Aust. J. Basic and Appl. Sci., 2 (1): 90- 98.

Abou El-Magd, M.M., A.A. Abd El-Fattah and E.M. Selim, 2009. Influence of mineral and Organic Fertilization Methods on Growth. J. Agric. Sci., 5(5): 582-589.

Abou El-Yazied, A., A.M. El-Gizawy, M.I. Ragab and E.S. Hamed, 2012. Effect of seaweed extract and compost treatments on growth, yield and quality of snap bean. Journal of American Science, 8: 1-20.

Abou-El-Hassan, S., M. Abd Elwanis, and M.Z. El-Shinawy, 2017. Application of compost and vermicompost as substitutes for mineral fertilizers to produce green beans. Egyptian Journal of Horticulture, 44: 155–163. https://doi.org/10.21608/ejoh.2017.1596.1019.

Ambrose, D.C., A., Manickavasagan and R. Naik, 2016. Leafy Medicinal Herbs: Botany, Chemistry, Postharvest Technology and Uses. CABI: pp.

Arthur, G.D., W.A. Stirk and J. Van Staden, 2003. Effect of seaweed concentrates on the growth and yield of three varieties of *Capsium annuum*, South. Afr. J. Bot., 69: 207 -211.

Ayesha, Kh., N. Haq, B.G. Jihene, R. Rafia and N. Farwa, 2015. Value Added Products, Chemical Constituents and Medicinal Uses of Celery (*Apium graveolens* L.) – A Review. International Journal of Chemical and Biochemical Sciences, 8:40-48.

Beckett, R.P., A.D. Mathegka and J. Van Staden, 1994. Effect of seaweed concentrate on yield of nutrient stressed tepary bean (*Phaseolus acutifolius* Gray): J. Appl. Phycol., 6:429-430.

Beigzadeh, S., A. Maleki, M.M. Heydar, A. Khourgami, and A. Rangin, 2019. Ecological and physiological performance of white bean (*Phaseolus vulgaris* L.) affected by algae extract and salicylic acid spraying under water deficit stress. Applied Ecoloy and Environmental Research,17(1):343-355.

Black, C.A., D.D. Evans, L.E. Ensminger., G.L. White and F.E. Clark, 1981. Methods of soil analysis. Part 2, 1-100, Agron. Inc. Madison. Wisc., USA.

Blunden, G., 1991. Agricultural uses of seaweeds and seaweed extracts. In: Guiry MD, Blunden G (eds) Seaweed resources in Europe. Uses and potential. Wiley, Chichester, 65–81

Chojnacka, K., and S.-K. Kim, 2013. Introduction of marine algae extracts. In: S.-K. Kim and K. Chojnacka, (Eds) Marine Algae Extracts- processes, products and applications, part 2. Wiley-VCH

Cottenie A., M. Verloo, L. Kiekens, G. Velgh and R. Camerlynch, 1982. Chemical analysis of plants and soils, Lab, Anal Agrochem. State Univ. Ghent Belgium, 63.

Crouch, I.J. and J. Van Staden, 1994. Commercial seaweed products as Bio-stimulants in horticulture Journal of Home and Consumer Horticulture, 1:19–76.

Darzi, M.T., M.R. Haj Seyed Hadi and F. Rejali, 2011. Effect of vermicompost and phosphate biofertilizer application on yield and yield components in anise (*Pimpinella anisum*, L.) Iran. J. Med. Aroma plants, 4(50): 451-465.

Destaillats, F. and P. Angers, 2002. Base-catalyzed derivatization methodology for FA analysis. Application to milk fat and celery seed lipid TAG. Lipids, 37(5): 527-532.

Doaa A.M. Gad, Hanaa A. Abd-Elrahman and Fatma S. Aboud, 2023. Response Growth, Yield, and Quality of Celery Plants to Foliar Spray with some Organic Extracts. J. of Plant Production, Mansoura Univ., 14 (1): 13 – 20.

Doaa A.M. Gad, Hanaa A. Abd-Elrahman and Fatma S. Aboud, 2023. Response Growth, Yield, and Quality of Celery Plants to Foliar Spray with some Organic Extracts. J. of Plant Production, Mansoura Univ., 14 (1): 13 – 20. DOI: http://dx.doi.org/10.15666/aeer/1701_343355.

Ewa, R., N.-W. Renata, S. Andrzej, and G. Piotr, 2016. The chemical composition of the essential oil of leaf celery (*Apium graveolens* L. VAR. *Secalinum ALEF*.) under the plants irrigation and harvesting method. Acta Sci. Pol. Hortorum Cultus, 15(1):147-157.

Featonby. S., B.C. and J. Van Stadena, 1983. The effect of sea weed concentrate on the growth of tomato plants in nematode – infested soil. Scientia Horticulturae, 20(2): 137-146.

Fornes, F., M. Sánchez-Perales, and J.L. Guadiola, 2002. Effect of a seaweed extract on the productivity of 'de Nules' Clementine mandarin and navelina orange. Botanica Marina 45: 486–489.

Gajewski, M., G. Katarzyna and J. Bobruk, 2008. The influence of Goëmar Goteo biostimulator on yield and quality of two Chinese cabbage cultivars. Conf.of biostimulators in modern agriculture "vgetable crops". Warsaw, 23-27.

Gunther, Z. and S. Josaph, 1978. Hand Book Series in Chromatography CRC press. Inc.

Hanaa A. Abd-Alrahman, M.F. Zaki, U.A. EL-Behairy, A.F. Abou Hadid and M.M. Abou EL-Magd, 2016. Growing broccoli plants in the newly reclaimed soils of Egypt, as affected by different fertilizer sources. International Journal of ChemTech Research, 9(5): 1-11.

Heftman, E., 1967. Chromatography Reinhold Pub. Crop. New York.

Hussein, M. S., 1995. Response of coriander and dill to different nitrogen sources Egypt. J. Hort., 22 (1):1-10.

Ismail E.G., Walid W.M., Salah K., Fadia E. S., 2014. Effect of manure and bio-fertilizers on growth, yield, silymarin content, and protein expression profile of Silybum marianum. Adv. Agric. Biol., 1(1):36-44.

Jackson, M.L., 1973. "Soil Analysis". Constable Co. Ltd., London, 1-15.

Jen, H.C., T.W. Jeng, C. Y. Chiu., 2008. The Combined Use of Chemical, Organic Fertilizers or Biofertilizer for Crop Growth and Soil Fertility. Soil and Environ, 10(2):1-12.

Kandeel, Y.R., E.S. Nofal, F.A. Menesi, K.A. Reda, M. Taher, and Z.Y. Zaki, 2001. Effect of some cultural practices on growth and chemical composition of Foeniculum vulgare, Mill. Proceeding 5th Arabi. Horti. Conf. Ismalia, Egypt, March 24- 28, 61-72.

Keller, F. and P. Matile, 1989. Storage of sugars and mannitol in petioles of celery leaves. New phytologist. 113(3): 291-299. [33] F. Destaillats, P. Angers. (2002). Base-catalyzed derivatization methodology for FA analysis. Application to milk fat and celery seed lipid TAG. Lipids. 37(5): 527-532

Khan, W., U.P. Rayirath and S. Subramanian, 2009. Seaweed extracts as bio-timulants of plant growth and development. J. Plant Growth Regul., 28(4): 386-399.

Kumar, R., N. Kumawat, and Sahu, Y.K., 2017. Role of biofertilizers in agriculture. Popular Kheti, 5: 63– 66.

Mancuso, S., E. Azzarello, S. Mugnai, X. Briand, 2006. Marine bioactive substances (IPA extract) improve foliar ion uptake and water tolerance in potted Vitis vinifera plants. Advances in Horticultural Science, 20: 156–161.

Mehta, C.M., U. Palni, I.H. Franke-Whittle, and A.K. Sharma, 2014. Compost: Its role, mechanism and impact on reducing soil-borne plant diseases. Waste Management, 34: 607–622. https://doi.org/10.1016/j.wasman.2013.11.012

Mesbah, B., D. Hadiseh, C.D.-P. Juan, N. Savithri, T. Leila and D. Mojtaba, 2023. Effects of organic and chemical nitrogen fertilization and postharvest treatments on the visual and nutritional quality of fresh-cut celery (*Apium graveolens* L.) during storage. Food Sci., Nutr., 11:320–333.

Mohamed, M.A.H. and M. Abdu, 2004. Growth and oil production of fennel (*Foeniculum vulgare* Mill.): effect of irrigation and organic fertilization. Bio. Agric. and Hort., 22: 31-39.

Mona M. Yousry, 2021. Peroxidase Isozyme Activity in Parsley and Celery Using Efficient Microbes, Kitchen Wastes and Other Combinations of Bio and Organic Fertilizers. Middle East Journal of Agriculture Research, 10 (4): 1063-1079.

Mona, M. Yousry and A. K. Abou El-Goud, 2021. Clean Agri-technique Efficiency Using Compost, Halex-2 and Seaweed on Yield and Quality of Okra. Middle East Journal of Applied Sciences, 11(01): 18-27.

Mooney, P. A. and J. Van Staden, 1985. Effect of seaweed concentrate on the growth of wheat under conditions of water stress. South. Afr. J. Sci. (81): 632 -633.

Naeem, M., J. Iqbal, and M.A.A. Bakhsh, 2006. Comparative study of inorganic fertilizers and organic manures on yield and yield components of mungbean (*Vigna radiat* L.). Journal of Agriculture and Social Sciences, 2:227–229.

Naveed, M., I. Mehboob, M.A. Shaker, M.B. Hussain, and Farooq, M., 2015. Biofertilizers in Pakistan: Initiatives and limitations. International Journal of Agriculture and Biology, 17, 411– 420. https://doi.org/10.17957/IJAB/17.3.14.672.

Ning, C.C., P.D. Gao, B.Q. Wang, W.P. Lin, N.H. Jiang, and K.Z. Cai, 2017. Impacts of chemical fertilizer reduction and organic amendments supplementation on soil nutrient, enzyme activity and heavy metal content. Journal of Integrative Agriculture, 16: 1819–1831. https://doi.org/10.1016/S2095-3119(16)61476-4

Opera, C.N. and J.E. Asigbu, 1996. Nutrient content of poultry manures and the optimum role for Egyptian fruit yield in a weathered tropical Ultisol Bid., Agric. and Hort., 13: 341- 350.

Papenfus, H.B., M.G. Kulkarni, W.A. Stirk, J.F. Finnie, and J. Van Staden, 2013. Effect of a commercial seaweed extract (Kelpak®) and polyamines on nutrient-deprived (N, P and K) okra seedlings. Sci. Hortic., 151: 142–146.

Rashed, M.M. Nahed, 2002. Effect of fertilization on the growth and storability of some aromatic plants. M. Sc. Thesis, Fac. Agric. Kafer EL-Sheikh, Tanta Univ, Egypt.

Rathore, S. S.R. Chaudhary, G.N. Boricha, A. Ghosh, B.P. Bhatt, S.T. Zodape, and J.S. Patolia, 2009. Effect of seaweed extract on the growth, yield and nutrient uptake of Soybean (Glycine max) under rainfed conditions. South African Journal of Botany, 75:351-355

Ravindran, B., S.M. Contreras-Ramos, and G. Sekaran, 2015. Changes in earthworm gut associated enzymes and microbial diversity on the treatment of fermented tannery waste using epigeic earthworm Eudrilus eugeniae. Ecological Engineering, 74: 394–401. https://doi.org/10.1016/j.ecoleng.2014.10.014.

Rożek, E.W.A, N.-W. Renata, S. Andrzej, and G. Piotr, 2016. The chemical composition of the essential oil of leaf celery (*Apium graveolens* L. Var. *Secalinum* ALEF.) under the plants irrigation and harvesting method. Acta Sci. Pol. Hortorum Cultus, 15(1):147-157.

Satyavati, G., M. Raina and M. Sharma., 1976. Medicinal plants of India. Indian Council of Medical Research New Delhi.

Shams, A.S. and Nahla M. Morsy, 2019. Nitrogen Sources and Algae Extract as Candidates for Improving the Growth, Yield and Quality Traits of Broccoli Plants. J. Plant Production, Mansoura Univ., 10 (5): 399 – 407.

Shehata S.M., Heba S. Abdel-Azem, A. Abou El-Yazied and A.M. El-Gizawy, 2011. Effect of Foliar Spraying with Amino Acids and Seaweed Extract on Growth Chemical Constitutes, Yield and its Quality of Celeriac Plant. European Journal of Scientific Research, 58(2): 257-265.

Shen, Z., S. Zhong, Y. Wang, B. Wang, X. Mei, R. Li, Y. Ruan, and Q. Shen, 2013. Induced soil microbial suppression of banana fusarium wilt disease using compost and biofertilizers to improve yield and quality. European Journal of Soil Biology, 57: 1–8. https://doi.org/10.1016/j.ejsobi.2013.03.006

Singh, A., N. Karmegam, G.S. Singh, T. Bhadauria, S.W. Chang, M.K. Awasthi, S. Sudhakar, K.D. Arunachalam, M. Biruntha, and B. Ravindran, 2020. Earthworms and vermicompost: An eco-friendly approach for repaying nature's debt. Environmental Geochemistry and Health, 42: 1617–1642. https://doi.org/10.1007/s10653-019-00510-4

Sivasankari, S.V.V., M. Anantharaj and M. Chandrasekaran, 2006. Effect of seaweed extracts on the growth and biochemical constituents of Vigna sinensis. Bioresource Technology, 97:1745–175.

Snedecore, W.C. and W.G. Cochran, 1980. Statistical Methods. 7 th ed., 2 nd printing. The Iowa State Univ. Press, Ames, Iowa, U.S.A.

Song, X., M. Liu, D. Wu, B.S. Griffiths, J. Jiao, H. Li, and F. Hu, 2015. Interaction matters: Synergy between vermicompost and PGPR agents improves soil quality, crop quality and crop yield in the field. Applied Soil Ecology, 89: 25–34. https://doi.org/10.1016/j.apsoil.2015.01.005

Taha, Z.S., T.A. Smira and M.S.R. Sanaa, 2011. Effect of bread yeast application and seaweed extract on cucumber (*Cucumis sativus* L.) plant growth, yield and fruit quality. Mesopotamia J. Agric., 39: 26-34.

Thirumaran G., M. Arumugam, R. Arumugam and P. Anantharaman, 2009. Effect of sea weed liquid fertilizer on growth and pigment concentration of Cyamopsis tetrogonolaba L. Taub. AmEuras. J. Agron., 2(2): 50 -56.

Turan, K. and M. Kose, 2004. Seaweed extract improve copper uptake of Grapevine (*Vitis vinifera*) Act Agric Scand , B, Soil Plant Sci , 54: 213- 220.

Whapham C.A., G. Blunden, T. Jenkins and S.D. Wankins, 1993. Significance of betaines in the increased chlorophyll content of plants treated with seaweed extract Appl Phycology, 5: 231 - 234.

Zaki, M.F., A.S. Tantawy, S.A. Saleh and Yomna I. Helmy, 2012. Effect of Bio-Fertilization and Different Levels of Nitrogen Sources on Growth, Yield Components and Head Quality of Two Broccoli Cultivars. Journal of Applied Sciences Research, 8(8): 3943-3960.

Zeinab, A. Salama, K.E. Farouk, Alaa A. Gaafar, and F.Z. Mohamed, 2013. Antioxidant activities of phenolics, flavonoids and vitamin C in two cultivars of fennel (*Foeniculum vulgare* Mill.) in responses to organic and bio-organic fertilizers. Journal of the Saudi Society of Agricultural Sciences, 14(1): 91-99.

Zenab A. Ahmed, 2017. Effect of NPK and Bio Fertilization on Growth and Oil Yield of Celery (*Apium graveolens* L.) and Dill (*Anethum graveolens* L.) Plants. J. Plant Production, Mansoura Univ., 8 (2): 247 – 251.

Zhang, X. and H. Ervin, 2004. Seaweed extract and humic acid contain cytokinins. Crop. Sci. 44 (5): 1509.

Zodape, S.T., V.J. Kawarkhe, J.S. Patolia and A.D. Warade, 2008. Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esulentus* L.) Journal of Scintific and Industrial Research, 67:1115 – 1117.