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Effect of fertilization by *Cladophora* sp. on biochemical characteristics of *Vigna radiate* & *Sesamum indicum* plants

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ABSTRACT:

An experiment was done in pots at the garden of biology department, College of Science, University of Thi-Qar during September until November 2018. The experiment aimed to Know the chemical content of Cladophora *sp.* and it use in soil amendment as organic fertilizer, as well as its effect on some biochemical characteristics (chlorophyll content, protein, carbohydrate and ash). The experiment contained the following treatments: control (c) no adding algae, (1%), (2%) (3%) wich adding *Cladophora sp.* as (300, 600, and 900) gm / 30 kg soil respectively. All *Cladophora sp.* treatments showed significant increase in all biochemical characters compared with the control. (3%) treatment gave significant increase as compared to other treatments in (chlorophyll content; protein content; shoot, carbohydrate content and ash content) in both plants.

Vigna radiate showed increasing percentage in chlorophyll content, protien, carbohydrates and ash (11.2% ,21.7%, 27.1% and 5.5%) respectively in T3(3%).As for *Sesamum indicum,* it also showed significant differences in biochemical characteristics in all the treatments and the highest values in (chlorophyll content, protien and carbohydrates) was (98.2%, 20.9% ,18.8% and 5.3%) respectively in T3(3%).

Keywords: *Cladophora sp., Vigna radiata* L, *Sesamum indicum*.

Introduction:

Biological fertilizers are significant to access of eco-friendly agricultural practices (Bloemberg et al., 2000). Bio-fertilizers contain principally the nitrogen fixing, phosphate solubilizing and plant growth promoting microorganisms (Goel et al., 1999). The main biofertilizers are Azotobacter, Azospirillium, blue green algae, Azolla, P-solubilizing microorganisms, mycorrhizae, and Sinorhizobium (Hegde et al., 1999). Green manures were also observed to induce root growth and make good yields (Boussiba, 1987; Mandimba et al., 1998). Algal biomass contains high percentage of macronutrients, elegant amount of micronutrients and amino acids (El Fouly et al., 1992; Mahmoud, 2001). Algal biomass as a new bio-fertilizer contain

macronutrients as well as micronutrients, some growth regulators, polyamines, natural enzymes carbohydrates, proteins and vitamins carry out for improving vegetative growth and yield (Shaaban, 2001 and Abd El-moniem and Abd-allah, 2008). Aside from, algae biomass to the soil improve soil characteristics that have suitable effect on nutritional status of plants (Al-Gosaibi, 1994).

Cladophora glomerata is a genus of filamentous branched green algae which forms free-floating mats in shallow waters or attached to the base of shallow pools for example, lakes and canals, in shaded littoral zones of lakes, and in slow streams stay connected to the substratum by abasal cell.

The objective of this study is to determine the effect of powder macroalgae Cladophora *glomerata* on biochemical characteristics of Vigna radiate & Sesamum indicum plants in the pots.

Materials and Methods:

Algal culture:

Macroalgae (*Cladophora sp.*) isolated from Euphrates River in Nassireya city in April 2018 Algal specimen were pressed and stored in 5% formalin for identification according to (prescot,1962). Biomasses of macroalgae were rinsed with fresh water to eliminate other materials such as sand, shells, etc. The macroalgae were stored in the laboratories to identified and dried at 50°C under ventilation in an oven and then grounded to powder form by the blender.

Chemical and physical analysis of soil and algae:

Soil and algae were collected from all the treatments and placed in Nylon bags, the samples were dehydrated and tested and passed from a 2 mm diameter sieve and packaged in plastic containers. The chemical and physical properties of soil and algae were determined by using pH and electrical conductivity (E.C.) meter (Jackson ,1958). Soil and algae organic matter(O.M.) was determined using the Smith-Weldon method as described in (Rhoades,1996) as shown in table (1).

Table (1) : Some chemical properties of Macroalgae (Cladophora sp.)

pH	E.C. (ds/m)	O.M. (gm/g)	N (mg/g)	P (mg/g)	K (mg/g)
7.8	4.8	14.4	17.5	2.4	1.2

Plant materials

The experimental plants used in this study were Vigna radiate & Sesamum indicum plants for planting in a pots , capacity is 30 kg soil per one pot. The experiment includes the following treatments: control (C) 0 gm algae/30 kg soil, (T1) 300 gm algae/ 30 kg soil, (T2)600 gm algae/30 kg soil and (T3) 900 gm algae / 30 kg soil.

Biochemical measurements of plant at the end of the experiment; chlorophyll, protein, and carbohydrate for shoots, roots and grains were recorded.

Determenation of Total Chlorophyll in Leavse:

Chlorophyll's concentration in fresh leaf blades was determined according to Arnon (1949). The absorbance (A) (B) of Chlorophyll's concentration was calculated according to (AOAC, 1990):
Chl.a = (12.7 (D 663) - 2.69(D 645)) ×V/(1000×W).

Chl.b = (22.9(D645) - 4.68(D 663)) ×V/(1000×W).

Total Chlorophyll (mg/g) = Chlorophyll a + Chlorophyll b

Determenation of Protein Percentage:

The protein percentage was extracted according to AOAC method (2000) after estimating the percentage of nitrogen in the plant, and estimated according to the following equation:
Percentage of protein =% of plant nitrogen × 2.60

Determenation of Carbohydrates Percentage:

The total carbohydrates were determined with the phenol-sulforic acid method (Dubois et al., 1956), as follow One ml. of aqueous extract was mixed with phenol (1ml. 5% w/v) and concentrated sulfuric acid (5ml.) was then added by fast delivery pipette. The mixture was then shaken gently and left to cool for 15 minutes The blank experiment was carried out using water instead of sugar solution. The developed yellow-orange color was measured at 490 nm.

Ash:

Heat the crucible for 30min in the muffle furnace set at 550±25ć. Allow the crucible to cool to 200. Transfer it to the desiccators and cool for 30min, and weigh it until the two recent weights difference is within 0.5mg.

Results & Discussion:

The addition of Cladophora *sp.* has led to changes in soil properties (chemical and physical) tab. (2) The (PH) value decrease in all alga treatment in the soil this may be due to the degradation of organic substance by microorganisms and the production of acids and thus reduce the degree of soil PH. On the contrary (E.C.) electrical conductivity increase in the values at the high level of addition alga and may be due to the containment of these algae on salt compare with control treatment (C).

The proportion of organic matter in the soil after the harvest increased with the level of addition of algae and reached this increase to 12.33gm/kg in T3. These results are consistent with what was found by (PiJuamet, al.2010) and (Hussein,2016).

Table (2) Some chemical and physical properties of soil

Treatments	pH	E.C. (ds/m)	Organic matter (gm/kgm)	Soil texture		
				Sand%	Clay%	Silt%
C	7.7	4.38	7.15	42	39	**19**
T1	7.5	4.42	9.56	42	39	**19**
T2	7.4	4.61	10.20	43	38	**19**
T3	7.1	4.89	12.33	44	38	**18**

Table (3,4) show the increase of chlorophyll content by increasing added of algae *Cladophora glomerata* in both study plant (*Vigna radiate and Sesamum indicu*m)**.**

The addition of organic fertilizer has led to an increase in the readiness of plant nutrients such as nitrogen, phosphorus and potassium, which is essential for the synthesis of the chlorophyll molecule essential for photosynthesis, which is reflected in the overall biological activity of the plant, including the formation of proteins and starchesm (O'Dell, 2003). As well as to increase due to the impact of hormones (Nelson and Van Staden, 1984)

Table (3) Effect of Chladophora algae on chlorophyll content in *Vigna radiate*

Fertilizer	Treatment	Chl.a (mg/g)	Chl.b (mg/g)	Total chl. (mg/g)	Increasing (%)
Control	0	1.47	0.66	2.13	**0%**
Chladophora	T1	1.67	0.74	2.41	**13.1%**
	T2	1.77	1.01	2.78	**30.5%**
	T3	2.58	1.92	4.50	**111.2%**

Table (4) Effect of *Chladophora* algae on chlorophyll content in *Sesamum indicum*

Fertilizer	Treatment	Chl.a (mg/g)	Chl.b (mg/g)	Total chl. (mg/g)	Increasing (%)
Control	0	1.86	0.79	2.65	0%
Chladophora	T1	1.98	1.20	3.18	20%
	T2	2.34	1.56	3.90	47.1%
	T3	3.12	2.13	5.25	98.1%

Protein content increasing in both plants as shown in table (5) and (6) ,in general, organic additives are important to increase the readiness of nutrients , increase the activity of microorganisms in the soil ,increase the quantity and then increase the effectiveness of enzymes

decomposing organic matter in the soil, which increases the readiness and absorption of plants as well as the impact of organic matter on soil moisture and microorganisms and increase its effectiveness Increasing the release of nitrogen as a result of the mineralization process ,the addition of organic matter and formation organic acid is increasing the proportion of nitrogen in the leaves as well as their work in reducing pH soil and improve its composition by increasing water retention and increasing ventilation, which increased roots growth Then good absorption of the elements available.

Table (5) Effect of *Chladophora* algae on protein content in *Vigna radiate*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total protein
Control	0	11.3	17.4	20.3	12.3%
Chladophora	T1	15.4	19.2	22.4	19.0%
	T2	16.3	20.6	22.9	19.9%
	T3	18.3	23.3	23.4	21.7%

Table (6) Effect of *Chladophora* algae on protein content in *Sesamum indicum*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total protein
Control	0	20.9	18.3	17.9	14.3%
Chladophora	T1	20.1	19.1	18.1	19.1%
	T2	21.8	20.1	19.3	20.4%
	T3	22.2	21.2	19.2	20.9%

In table (7) and (8) show the percentage of carbohydrate in both study plants which increasing by increase the adding of *Cladophora* algae and that may be due to organic matter that found in algae, that improve the roots of plants and make them more permeable, increasing their ability to absorb water and nutrients in the soil, and because of the acids that help.

Table (7) Effect of *Chladophora* algae on carbohydrate content in *Vigna radiate*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total carbohydrates
Control	0	22.8	18.7	41.2	20.7%
Chladophora	T1	17.9	20.3	38.3	25.5%
	T2	19.2	20.6	38.2	26.0%
	T3	19.8	21.3	40.3	27.1%

Table (8) Effect of *Chladophora* algae on carbohydrate content in *Sesamum indicum*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total carbohydrates
Control	0	13.4	19.8	18.9	13.0%
Chladophora	T1	13.1	19.1	18.3	16.8%
	T2	13.8	20.2	19.1	17.7%
	T3	14.5	21.5	20.3	18.8%

The rate of inorganic substances increased by increasing the addition of algae as well as by increasing the addition of sludge significantly increased under the probability level of 5% as shown in table (9) and (10).

Decomposition of fertilizers, which contain organic material (*Cladophora* 12.4) that produces a number of organic acids that reduce the degree of reaction of the soil, also able to grasp the microelements in chelating, whether free from residues or originally in the soil, which reduces their exposure to absorption The seizures meanwhile effectively contribute to filling the need of two study plant of these elements.

Table (9) Effect of *Chladophora* algae on ash content in *Vigna radiate*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total ash
Control	0	2.1	0.8	1.4	4.3%
Chladophora	T1	2.1	1.0	1.6	4.9%
	T2	2.3	1.1	1.6	5.0%
	T3	2.4	1.3	1.8	5.5%

Table (10) Effect of *Chladophora* algae on ash content in *Sesamum indicum*

Fertilizer	Treatment	Shoots (%)	Roots (%)	grains (%)	Total ash
Control	0	2.3	1.1	1.2	4.6%
Chladophora	T1	2.4	1.3	1.3	5.0%
	T2	2.4	1.5	1.3	5.2%
	T3	2.5	1.5	1.3	5.3%

CONCLUSION:

1- Organic matter (algae) can be converted to organic fertilizer that's due to Minimize the use of chemical fertilizers
2- Improve the qualities of soil chemical and physical
3- The best productivity in both plants (*Vigna radiate & Sesamum indicum*) was in the T3 (900g clad. /30kg soil).

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