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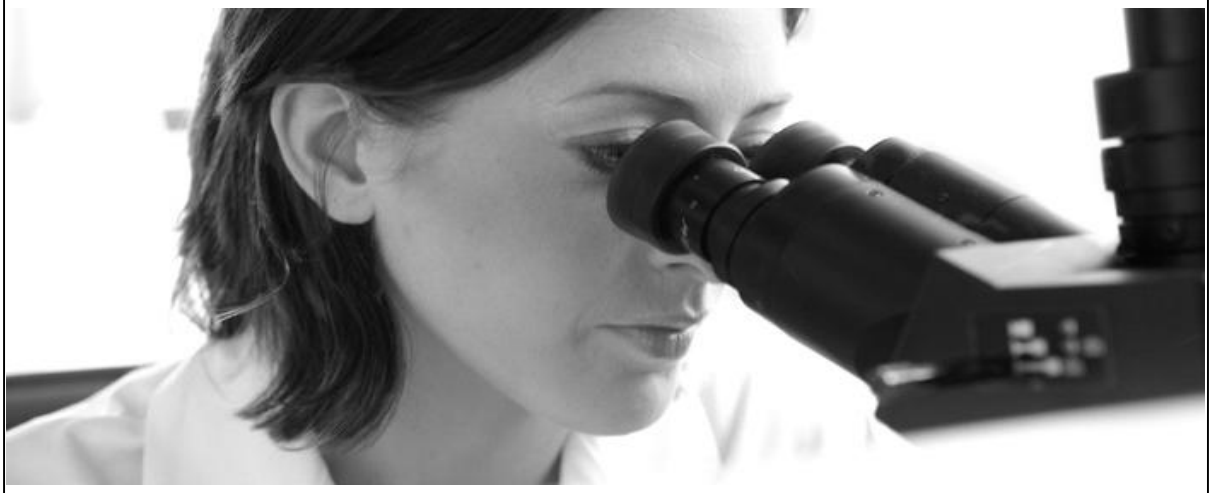

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RESEARCH ARTICLE

STUDIES ON THE EFFECT OF SOIL AMENDMENT SEAWEED FERTILIZER (SSF) OF *BOTRYOCLADIA LEPTOPODIA* (J.AGARDH) KYLIN (RED ALGAE) ON GROWTH AND BIOCHEMICAL CONSTITUENTS OF *CICER ARIETINUM* (CHICK PEA)

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ABSTRACT

Application of seaweed material as soil amendment may uniquely affect soil quality parameters as a result of its chemical characteristics and stimulate growth parameters and biochemical composition of the yield. In this study, the putative benefits of soil amendment red seaweed *Botryocladia leptopodia* (J.Agardh) Kylin were assessed in *Cicer arietinum* (chick pea) for crop growth and production. In the present study the plant exhibited highest seed germination (93.3%), shoot length (18.74cm), fresh weight (0.566 mg/g fr.wt) and moisture content (0.6713mg/g fr. wt) chlorophyll a (0.942mg/g fr.wt) chlorophyll b (0.371mg/g fr.wt) total chlorophyll content (1.285 mg/g fr.wt) carbohydrate content (16.8 mg/g fr.wt) and protein content (15.53 mg/g fr.wt) at lower concentration (10%) and in some cases 5% concentration of SSF showed stimulatory effect and 20% concentration shows inhibitatory effect.

INTRODUCTION

In modern agriculture, Marine macro algae, or seaweed are applied as a soil amendment material as a low cost source of nutrient-rich biomass. Seaweed compost and extract products have been widely evaluated for agricultural applications [1] to improve crop yield, seed germination, insect and fungal disease resistance, and low temperature tolerance [2]. Despite these other potential benefits seaweed products are mainly sold as fertilizers. Seaweed contain a number of micronutrients including Mg, S, Fe, Mn, Zn, B, Cl, and Na. Plants deficient in these trace elements could respond noticeably even if only small amounts are added. Researchers also found that seaweed contains a number of plant growth hormones, including cytokinins, gibberellins, abscisic acid, and indoleacetic acid, & phenolic compounds [3]. Seaweed products exhibit growth-stimulating activities, and the use of seaweed formulations as bio stimulants in crop production is well established [4]. Application of seaweeds and seaweed extracts triggers the growth of beneficial soil microbes and secretion of soil conditioning substances by these microbes.

MATERIAL & METHODS

Collection, Handling & Storing of Seaweeds

The Seaweeds specimens were collected in the month of March and April 2014 from Buleji, the coastal areas of Karachi, Pakistan (Fig. 1). The collected seaweed species were washed thoroughly with sea water on the spot to remove the adhering sand particles and epiphytes. The samples were again rinse thoroughly with tap water in Research laboratory of Jinnah University for Women to remove the surface salt and minute particles of sand and then blotted to remove excess water and stored in refrigerator for further process.

Preparation of Seaweed Fertilizer

The collected seaweeds *Botryocladia leptopodia* were dried and decomposed under maximum light and air. Dried material was finely powdered with the help of grinder and use to make different concentrations of seaweed fertilizer. five gram (5g), ten gram (10g) and twenty gram (20g) of finely powdered

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material was mixed separately with 1kg soil each The resulting mixture was taken as 5% , 10 % and 20% concentration of the Soil Amendment Seaweed fertilizer (SSF). The set up was three replicates each (Fig. 2-5). Chemically sterilized, healthy seeds of chick pea (*Cicer arietinum*) sown in pots were uprooted carefully after a month and subjected to analyze for physical growth parameters and some essential biochemical contents in *Cicer arietinum*. Total protein was estimated by using the Lowry's method [5], soluble carbohydrate content was estimated by using with Anthrone reagent as described by Yemm and Willis, 1954[6]. Chlorophyll was estimated by Arnon method, 1949 [7].The mean values were expressed in (mg/g.fw). Triplicate samples were used for all the treatment and the mean values were presented in Table 1.

Fig 1 Collecting seaweeds from Buleji, Karachi coast

Fig 2 Seedling of plant *Cicer arietinum* Grown under control condition (garden soil)

Figs 3-5 Seedling of plant *Cicer arietinum* grown under condition of 5%, 10% and 20% concentration of Soil Amendment Seaweed Fertilizer (SSF)

Table 1 Effect of Different concentration of seaweed fertilizer of (*Botryocladia leptopodia*) on Growth parameters, Germination rate, Root length, Shoot length and Total Fresh Weight of plant *Cicer arietinum* (chickpea)

S.No	Germination Rate (%)	Root length (cm)	Shoot length (cm)	Total Fresh weight (gm)
Control	86.6 (0)	10.15 (0)	17.82 (0)	0.396 (0)
5%	93.3 (+7.73)	8.23 (-18.98)	18.6 (+4.35)	0.365 (-7.82)
10%	90 (+3.92)	7.96 (-21.63)	18.74 (+4.91)	0.566 (+42.92)
20%	70 (-19.16)	3.97 (-60.91)	12.68 (-28.85)	0.211 (-46.71)

The tabulated values are the standard mean readings of three replicates. The value in parenthesis indicates percent increase or decrease (+/-) over control

Table 2 Effect of Different concentration of seaweed fertilizer of (*Botryocladia leptopodia*) on growth parameters Fresh weight, Dry weight and Moisture content of plant *Cicer arietinum* (Chickpea)

S.No	Fresh weight (gm)	Dry weight (gm)	Moisture content (gm)
Control	1.08 (0)	0.530 (0)	0.550 (0)
5%	1.114 (+3.14)	0.443 (-16.41)	0.671 (+22.00)
10%	0.704 (-53.40)	0.481 (-9.24)	0.233 (-57.63)
20%	0.594 (+45.00)	0.231 (-56.41)	0.363 (-34.00)

The tabulated values are the standard mean readings of three replicates. The value in parenthesis indicates percent increase or decrease (+/-) over control

Table 3 Effect of Different concentration of seaweed fertilizer of (*Botryocladia leptopodia*) on photosynthetic pigments chlorophyll a , b and total chlorophyll on leaves of *Cicer arietinum* (chickpea)

S.No	Chl a (mg/g fr.wt)	Chl b (mg/g fr.w)	T.Chl (mg/g fr.w)
Control	0.545 (0)	0.297 (0)	0.843 (0)
5% SWF	0.539 (-1.10)	0.21 (-29.29)	0.749 (-11.15)
10% SWF	0.942 (+72.84)	0.371 (+24.91)	1.285 (+52.43)
20% SWF	0.333 (-38.89)	0.132 (-55.55)	0.465 (-44.83)

The tabulated values are the standard mean readings of three replicates. The value in parenthesis indicates percent increase or decrease (+/-) over control

Table 4 Effect of Different concentration of seaweed fertilizer (*Botryocladia leptopodia*) on biochemical parameters parameters Total protein content and carbohydrates content of Cicer *arietinum* (chickpea)

S.No	Protein (mg/g fr.w %)	Carbohydrate (mg/g fr.w %)
Control	10.32 (0)	14.8 (0)
5% SWF	14.76 (+43.02)	15.9 (+7.43)
10% SWF	15.53 (+50.48)	16.8 (+13.51)
20% SWF	3.9 (-62.20)	6.9 (-53.37)

The tabulated values are the standard mean readings of three replicates. The value in parenthesis indicates percent increase or decrease (+/-) over control

RESULT & DISCUSSION

The application of *Botryocladia leptopodia* (J.Agardh) Kylin as Soil Amendment Seaweed Fertilizer (SSF) improved some growth parameters including shoot length, root length of *Cicer arietinum* (Table 1). The highest shoot length (18.74cm) was observed at 10% concentration and the lowest value of shoot length (12.68cm) was recorded at 20% concentration of Soil Amendment Seaweed Fertilizer (SSF) of *Botryocladia leptopodia* . A meaningful effect in shoot length (12.68cm-18.74cm) of of *Cicer arietinum* was observed at 5%, and 10% concentrations of SSF (*Botryocladia leptopodia*) as compared to control plant. The maximum stimulating effect on shoot length of plants were +4.91% and +4.34% attained with 5% and 10% SSF (18.74cm and 18.0 cm respectively) and inhibitory effect on shoot length of plants were -28.85 % attained at 20% SSF. The root length of *Cicer arietinum* (chickpea) varied from 10.15 to 3.97cm/seedlings shown in Table2. The concentrations of SSF (5%, 10% and 20%) all show inhibitory effect on root length and it was decreased when compared to control the values showed that the decreased of root length from 21.63% to 60.91 %. Root length of *Cicer arietinum* was decreased at all from -18.98 to -60.91 The maximum value 8.23cm occurs at 5% SSF and the minimum value (3.97cm) occurred at 20% concentration of SSF (Fig 1).

The dry weight of *Cicer arietinum* values varied from 0.530 to 0.231 gm/seedlings and Moisture content of plants *Cicer arietinum* varies from 0.671gm to 0.363gm showed meaningful effect on 5% concentration. The stimulating effect on moisture content of plants was +22.00% attained at 5% and there after it showed a declining manner. All treatments show inhibitory effect on dry weight. Fresh weight of *Cicer arietinum* ranged from 0.566 to 0.211gm/Seedlings (Table 2). The greatest values (0.566gm) occurred at 10% and the lowest value (0.211) obtained at 20% concentration of Soil Amendment Seaweed Fertilizer (SSF) of *Botryocladia leptopodia*. The fresh weight was increased up to +42.92 % at 10% SSF and there after it showed a declining manner (Fig 1).

The Chlorophyll 'a' in *Cicer arietinum* ranged from 0.942 to 0.333 (mg/g fr.wt) and the highest concentration increase up to +72.84 % it was 0.942 mg/g fr.wt at 10% SSF.The minimum Chlorophyll 'a' 0.333 mg/g fr.wt was recorded at 20% concentration of SSF. The Chlorophyll 'b' (0.371 to 0.132 (mg/g fr.wt)) with highest concentration increase up to +24.9 % and it was 0.371 mg/g fr.wt at 10% SSF and thereafter and before decreasing trend of chlorophyll 'b' when compared to control. The minimum Chlorophyll 'b' was 0.132 mg/g fr.wt decreased down onto -55.55 % records at 20% concentration of SSF. The Total Chlorophyll content ranges from (1.285 to 0.465 mg/g fr.wt). The Higher increased was +52.43% was 1.285 mg/g fr.wt observed at 10% concentration of SSF and the minimum 0.465 mg/g fr.wt was total chlorophyll 'content observed at 20% concentration of SSF and it was decreased onto -44.83% (Table 3).

The experimental plant significantly increased pigment values of (72.82%, 24.91% and 52.43%) were obtained at 10% concentration respectively chlorophyll a b and total chlorophyll content. The high chlorophyll content in the plant treated with low concentration of seaweed liquid fertilizer may be due to the presence of beatings as reported by Blunden *et al* [8]. Mostafa and Zheekh [9] reported that the plant growth substance present in seaweed liquid fertilizer enhances the chlorophyll contents in the leaves. Among the two plant growth regulators investigated in the present attempt, the amount of cytokinin was found high compared to auxin in both SLFs.

The protein content of in *Cicer arietinum* ranges from 15.53 to 3.9 % mg/g fr.wt and the maximum values 15.53 and 14.56 mg/g fr.wt increased up to 43.02 % and 50.48 % was obtained at 5% and 10% concentration of SSF respectively. The minimum value 3.9 % mg/g fr.wt was observed at 20% concentration of SSF and it was decreased onto -62.20% when compared to control plants shown in Table 4.

The carbohydrate content ranged from 6.9 % to 16.8 mg/g fr.wt showed increased value up to +13.51% with 10% concentration of SSF as compared to control plant. The minimum 6.9 %mg/g fr.wt and decreased onto -53.37% when compared to control plant .The protein and carbohydrate values were increased at 10% concentration of SSF as compared to control plant (Table 4).

The analyzed data showed the positive effect of soil amended seaweed fertilizer (SSF) of *Botryocladia leptopodia* (red algae) on growth and germination of *Cicer arietinum*, 10% seaweed application was significant to promote germination and shoot length of experimental plant along with carbohydrate and protein content over control plant. The ameliorating effect of the SSF may be due to the growth hormones [8, 10-11]. At low 5% and high 10% rate the treatment reduce or less promote the growth and germination due to insufficient supply of nutrients as compare to 10% application. The germination percentage showed promotion at the rate of 7.73% and +3.92 over control. Similarly the maximum stimulating effect on shoot length of plants were 4.91% and 4.34% attained with 5% and 10% SSF.

Whereas, the Root length of *Cicer arietinum* was decreased at all from 18.98% to 60.9% over control this inhibition in growth in the presence of seaweed fertilizer is due to the chemical structure and biological activity of extracts from seaweed it is shown, that toxicity of extracts of sea seaweed above, than [12] and the highest antimicrobial activity detected [13].

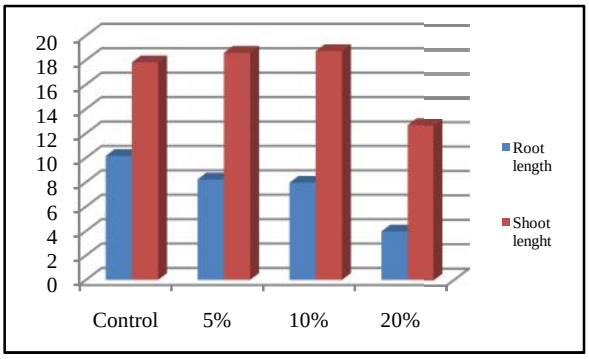

Fig 1 Effect of SSF on Root and Shoot length of plant chick pea

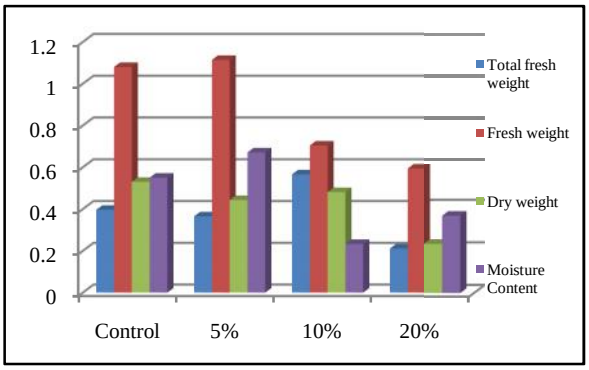

Fig 2 Effect of SSF on Total fresh weight of plant and Fresh weight, dry weight and moisture content of chick pea

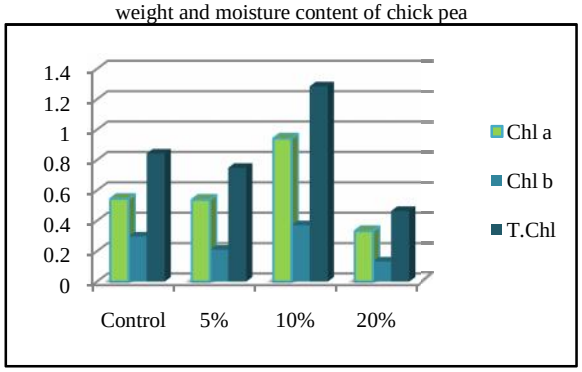

Fig 3 Effect of SSF on Chlorophyll pigments a, b and Total Chlorophyll content of plant chick pea

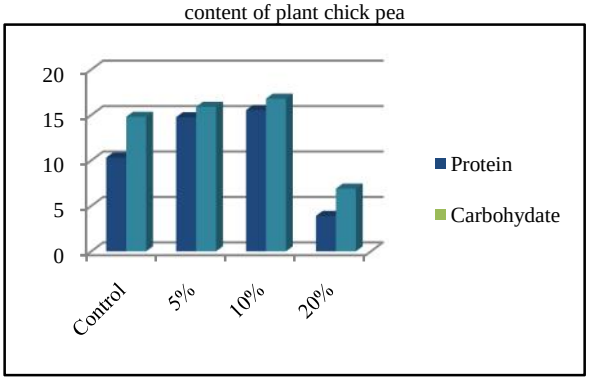

Fig 4 Effect of SSF on Total Protein and Total Carbohydrate content of plant chick pea

CONCLUSION

The present study suggested that the application of the Soil Amendment Seaweed Fertilizer (SSF) from *Botryocladia leptopodia* can be used at low concentrations for enhancing the seed germination and seedling growth of cultivated crops as well as enhancer of biochemical attribute of *Cicer arietinum* (Chick pea).

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