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STUDIES ON THE INFLUENCE OF SEAWEED LIQUID FERTILIZER OF *COLPOMENIA SINUOSA* (MERT. EX ROTH) DERBES & SOLIER (BROWN SEAWEED) ON *PENNISETUM GLAUCUM* (L.) R. Br., IN THE SOUTH EAST COAST OF TAMIL NADU, INDIA.

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ABSTRACT

The present study was carried out to investigate the influence of Seaweed Liquid Fertilizer (SLF) of the brown seaweed *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on the seed germination, shoot length, root length, biochemical contents and pigment characteristics of *Pennisetum glaucum* (L.) R.Br. Experiments were conducted on *Pennisetum glaucum* (L.) R.Br. to study the potential brown seaweed *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier as a biofertilizer. The Seaweed Liquid Fertilizer was prepared in four different concentrations separately (2.5%, 5.0%, 7.5% and 10%). The 10% concentration of SLF showed the best positive results on seed germination, shoot length, root length, biochemicals such as total carbohydrates, total proteins, total lipids, total phenols and pigments namely total chlorophylls, total caraotenoids. The data generated from the present study reveal that the Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier can be used as biofertilizer to increase the product of *Pennisetum glaucum* (L.) R.Br.

KEY WORDS

Seaweed, SLF, *Colpomenia sinuosa*, *Pennisetum glaucum* and Biochemicals.

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INTRODUCTION

From the time immemorial the seaweeds have been closely associated with human life and are being meticulously used in numerous ways as a source of food, feed, fertilizer, medicine and chiefly for economically important phycocolloids[1]. In India, seaweeds are mainly used for the commercial production of phytochemicals namely agar, agarose, carrageenan and seaweed liquid fertilizer. Knowledge of the chemical composition of

seaweeds is both important for the assessment of nutritional value to marine invertebrate or vertebrate herbivores, for the evaluation of potential sources of protein, carbohydrate and lipid for commercial use or for possible human consumption[2].

Any improvement in agricultural system that results in higher production should reduce the negative environmental impact and enhance the sustainability of the system. One such approach is the use of biostimulants which can enhance the effectiveness of conventional mineral fertilizers. Due to these reasons the farmers are being compelled gradually day by day to turn towards various options like organic manures, biostimulants, growth regulators etc. One of such options is the use of seaweed extracts as plant nutrient bearing fertilizer. Marine bioactive substances extracted from seaweeds are used in agricultural and horticultural crops and many beneficial effects may be achieved in terms of enhancement of yield and quality[3]. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various cereals, pulses and different vegetable species.

Seaweed extracts contain major and minor nutrients, amino acids, vitamins, cytokinins, auxin and abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants develop tolerance to environmental stress [4], increase nutrient uptake from soil[5] and enhance antioxidant properties. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various grasses, cereals flowers and vegetable species[6]. In recent years, the use of seaweed extracts have gained in popularity due to their potential use in organic and sustainable agriculture especially in rain fed crops as a means to avoid excessive fertilizer applications and to improve mineral absorption. Unlike chemical fertilizers, extracts derived from seaweeds are biodegradable, nontoxic, non-polluting and non-hazardous to humans, animals and birds[7].

On the other hand, to nourish the protein energy malnourished people and to maintain soil health properly cereal crops should be included in the cropping system. *Pennisetum glaucum* (L.) R.Br. is the important food cereal grown and consumed in various parts and states of India and is a good source of carbohydrates and minerals and its carbohydrates quality is very high. Considering each and every part of the above reasons, an experiment was conducted to study the influence of different Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on the growth, biochemicals and pigments of *Pennisetum glaucum* (L.) R.Br.

MATERIALS AND METHODS

Collection of sample

Colpomenia sinuosa (Mert. ex Roth) Derbes & Solier (Figure No 1) is brown seaweed shows much attention in the recent years due to native vegetation. *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier was collected from Koothankuzhi, Tirunelveli district in the south east coast of Tamil Nadu, India during the month of January 2014. Samples were rinsed with marine water to remove debris and epiphytes. The entire epiphytes were removed using soft brush. In the laboratory, the seaweeds are once again washed in freshwater and stored in refrigerator for further analysis [8].

Selection and Surface Sterilization of Seeds

Pennisetum glaucum (L.) R.Br. is one of the common cereals and cultivated since ancient times in India. *Pennisetum glaucum* (L.) R.Br. is grown in almost all the states of India. Therefore, *Pennisetum glaucum* (L.) R.Br. was chosen in the present study. About 100 seeds the test plant immersed in a beaker of water. The seeds which floated on the surface of water were removed. The seeds which sunk to the bottom of the beaker were selected for the study [9]. The selected seeds were washed in running tap water for 5 minutes and rinsed with distilled water for 5 minutes. After washing, the seeds were sterilized by keeping in 0.1% mercuric chloride for 5 minutes. The surface sterilized seeds were washed in distilled water and rinsed 5 times for 5 minutes each[10]. The surface sterilized and rinsed seeds were employed for the present study.

Preparation of Seaweed Liquid Fertilizer

Air dried *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier sample was finely ground with mortar and pestle and 10g was weighed on electronic balance. 100ml distilled water was added. The mixture was incubated for two days (48h). Thereafter, the extract was filtered through Whatman No.1 filter paper. Now, the extract was made up into 100ml with distilled water (10%). From this, various concentrations of extract were prepared using distilled water in the following manner was shown in Table No.1.

Bio Assay

Ten seeds of *Pennisetum glaucum* (L.) R.Br. were germinated in shade using Petri plates at room temperature (33°C) for each treatment. For each treatment, 10 seeds were placed in sterilized Petri plates on Whatman No.1 filter paper and 5ml of aqueous extractions (2.5%, 5.0%, 7.5% and 10%) were added on the first day. Controls were treated with an equal volume of distilled water[11]. The same volume of extracts and distilled water were added on subsequent days on daily basis[12]. The treatments were replicated three times in a completely randomized manner. Followed by total carbohydrates[13], total protein[14], total lipid[15], total phenol[16], total chlorophyll and total carotenoids[17] were also estimated. The results obtained were tabulated and presented in the figures.

RESULTS AND DISCUSSION

Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on Shoot and Root Length of *Pennisetum glaucum* (L.) R.Br.

The Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier was used as base for *Pennisetum glaucum* (L.) R.Br. Germination of seed was observed on 4th day and frequency of germination was found to be 100% in control and all the treatments. The experiment results showed the stimulation both in shoot and root growth. Average shoot length in control was found to be 4.8cm (100%). The minimum stimulation of shoot length was recorded 5.2cm in 2.5% concentration of SLF (8.33%). Followed by the shoot growth was increased to 5.9cm in 5.0% (22.91%) and 6.3cm in 7.5% (31.25%). When the concentration of SLF increased to 10%, the maximum stimulation of shoot length was reached to 6.9cm (43.75%). Average root length in control was found to be 7.5cm (100%). The minimum stimulation of root length was observed at 8.2cm in 2.5% concentration of SLF (9.33%). Followed by the root growth was increased to 8.8cm in 5.0% (17.33%) and 9.6cm in 7.5% (28.00%). When the concentration of SLF increased to 10%, the maximum stimulation of root length was reached to 10.3cm at 37.33% (Table No 2 & Figure No 2).

After the treatment of various concentration of SLF on *Pennisetum glaucum* (L.) R.Br., the plants were examined for various biochemical compounds and pigments (Table No 3). As shown in Figure No 3, Total carbohydrates content in control was 198mg/gm, followed by increasing trend of carbohydrates was observed in 2.5% (228mg/g), 5.0% (249mg/g), 7.5% 267mg/g) and 10% (290mg/gm). Total protein content in control was 136mg/gm, followed by 2.5% (151mg/g), 5.0% (173mg/g), 7.5% (193mg/g) and 215mg/gm in 10%. Total lipid in control was found to be 76mg/g. The amount of lipid in 2.5% was 85mg/g, followed by increasing trend was observed to 97mg/g (5.0%), 108mg/g (7.5%) and 126mg/g (10%). Total phenol content in control was 79mg/gm, followed by increasing trend of phenols was noted in 2.5% (97mg/g), 5.0% (109mg/g), 7.5% (119mg/g) and 10% (137mg/gm). As presented in Figure No 4, Total chlorophyll content in control was 2.99mg/gm, followed by 2.5% (3.46mg/g), 5.0% (3.69mg/g), 7.5% (3.72mg/g) and 3.88mg/gm in 10%. Total carotenoid in control was recorded to be 0.97mg/g. The carotenoid content in 2.5% was 1.18mg/g, followed by increasing trend was observed to 1.39mg/g (5.0%), 1.56mg/g (7.5%) and 1.97mg/g (10%). When the concentrations of Seaweed Liquid Fertilizer *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier were increased, all the phytochemical content was also increased.

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As a step toward the expansion of nature source of other manures, Seaweed Liquid Fertilizer application will be useful in enriching the soil and achieving higher production in the place of costly chemical fertilizer. In the developing world, the use of Seaweed Liquid Fertilizer should be urged to avoid environmental pollution by heavy doses of chemical fertilizer in the soil. The beneficial effect of Seaweed Liquid Fertilizer on agricultural plants includes improving the growth, yield and the ability to with stand adverse environmental conditions[18]. The earlier work has similar to the present study, the growth, yield, biochemicals and pigments were rich in SLF treated. In the present study the percentage of seed germination found to be 100% in plants received 2.5%, 5.0%, 7.5% and 10%. Aitkin and Senn [19] recorded lower concentration seaweed extract showed increased seed germination on ornamental plants, tobacco, pea and cotton. Dhargalkar and Untawale [20] reported that SLF treatment enhanced the rate of seed germination in green chilies and turnip and found that lower concentrations of SLF increase the germination percentage than the higher concentration. Similar observation was made in maize, ragi and Kambu[21], *Sesmun* [22] *Oryza sativa* [23] and Cowpea[24].

In the present investigation, seeds treated with lower concentration (10%) with SLF show better response in terms of shoot and root length, biochemicals and pigments. Similar observation was made by some earlier workers. Stephenson[25] recorded that lower concentration of SLF prepared from *Ascophyllum* and *Laminaria* accelerated the growth in maize. Blunden and Wildgoose[26] reported a marked increase in lateral root development in potato plants as a result of treatment with seaweed extract. Similar results were recorded in *Padina*, which induced maximum growth in *Cajanus cajan* [27]. Thirumaran *et al.*, reported with *Chaetomorpha antennina* [28] and *Rosenvingea intricata*[29] on the growth of *Abelmoschus esculentus* and *Raphanus sativus*. It was also reported similar findings with *Hypnea musiformis, Spatoglossum asperum, Stoechosperum marginatum* and *Sargassum* on the growth of green chillies, turnips and pineapples and Cluster bean [30]. The SLF treatment also increased total chlorophyll and carotenoids content of both the test plants at lower concentration (10%) SLF. The present findings coincide with some earlier findings. Whapham *et al* [31] observed that the application of SLF of *Ascophyllum nodosum* increased the chlorophyll of cucumber cotyledons and tomato plants. Rama Rao[32] also reported that the dry powder and liquid formulators of the seaweed *Sargassum wightii* increased the growth of tomato plants further the dry powder was effective at a low dose.

Table No.1: Preparation of Seaweed Liquid Fertilizer

S. No	Percentage of Conc.	Extracts (ml)	Distilled water (ml)
1	Control	-	100
2	2.5%	25	75
3	5.0%	50	50
4	7.5%	75	25
5	10%	100	-

Table No.2: Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on shoot and root length of *Pennisetum glaucum* (L.) R.Br.

S. No	Treatment	Seed germination (%)	Shoot length (cm)	Increased Shoot length (%)	Root length (cm)	Increased root length (%)
1	Control	100	4.8±0.07	-	7.5±0.22	-
2	2.5%	100	5.2±0.21	08.33	8.2±0.17	09.33
3	5.0%	100	5.9±0.22	22.91	8.8±0.19	17.33
4	7.5%	100	6.3±0.41	31.25	9.6±0.06	28.00
5	10%	100	6.9±0.12	43.75	10.3±0.20	37.33

Table No.3: Effect of Seaweed Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on different Biochemicals of *Pennisetum glaucum* (L.) R.Br.

Biochemicals (mg/g)	Concentration of Plant Extracts				
	Control	**2.5%**	**5.0%**	**7.5%**	**10%**
Total Carbohydrates	198*	228*	249*	267*	290*
Total Proteins	136*	151*	173*	193*	215*
Total Lipids	76*	85*	97*	108*	126*
Total Phenols	79*	97*	109*	119*	137*
Total Chlorophylls	2.99*	3.46*	3.69*	3.72*	3.88*
Total Carotenoids	0.97*	1.18*	1.39*	1.56*	1.97*

* An average of Triplicates

Figure No.1. Natural Habit of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier

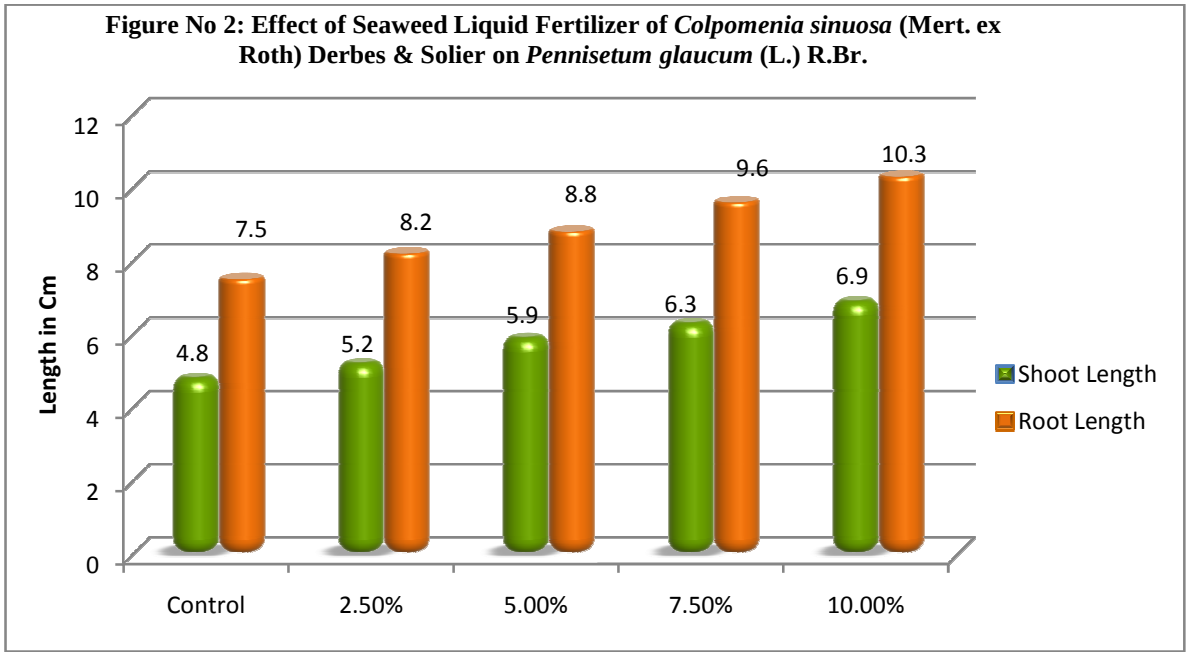

Figure No.2: Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on Biochemicals synthesis

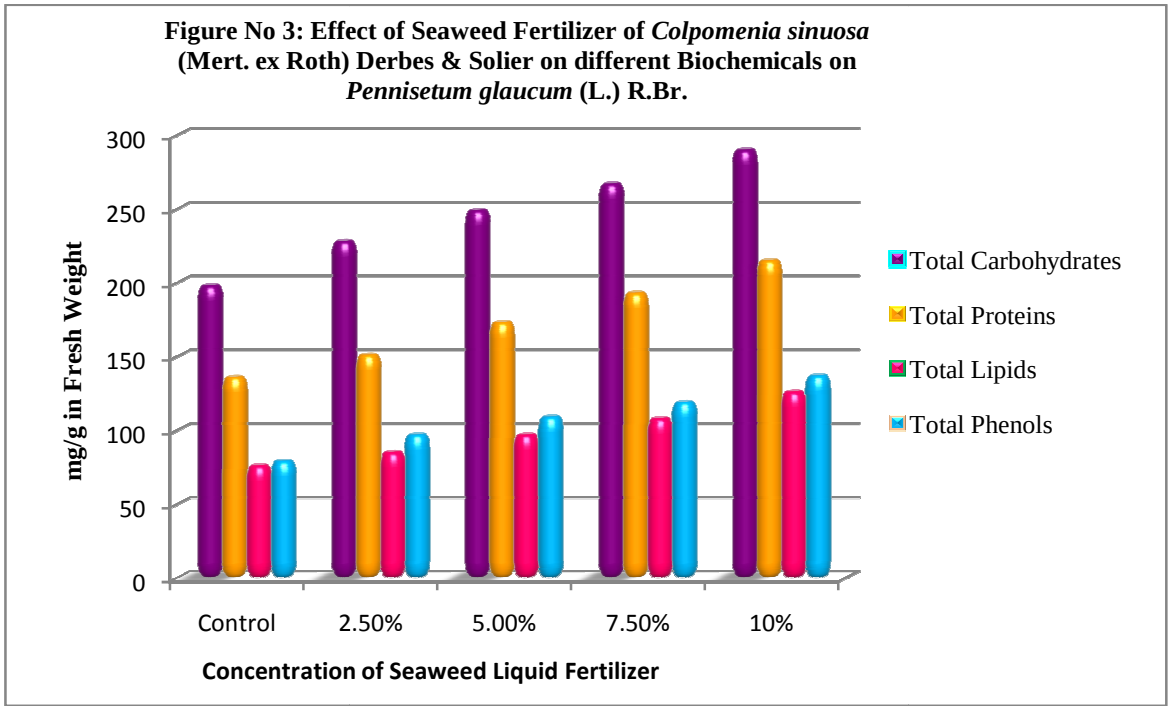

Figure No.3: Effect of Seaweed Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on different Biochemicals on *Pennisetum glaucum* (L.) R.Br.

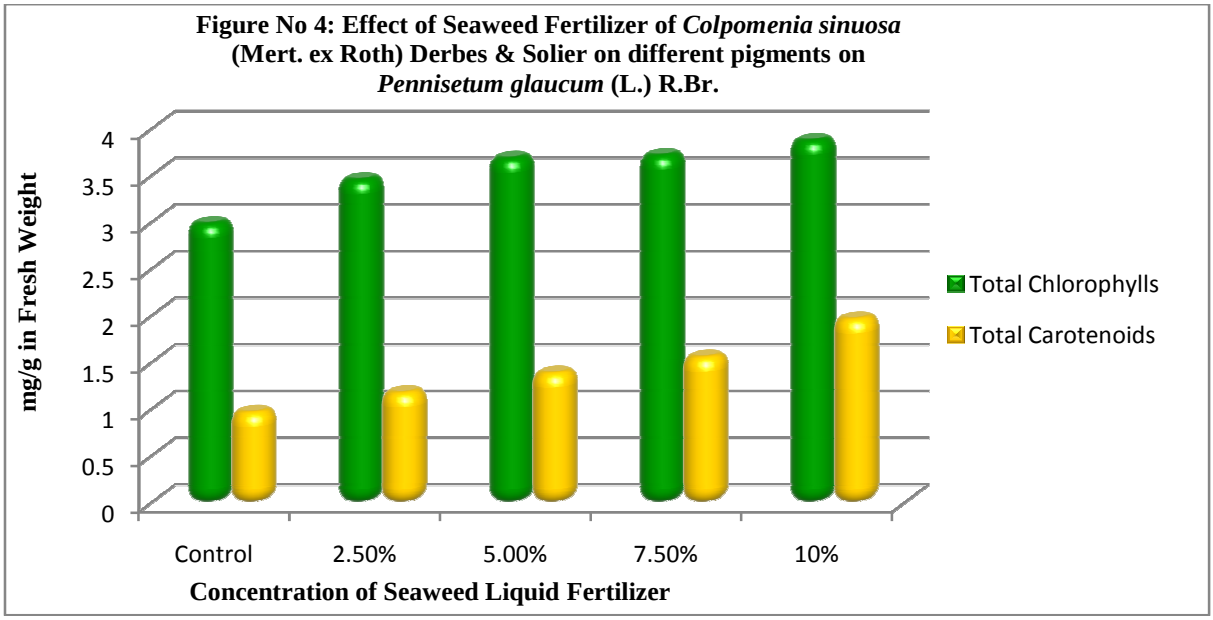

Figure No.4: Effect of Seaweed Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on different pigments on *Pennisetum glaucum* (L.) R.Br.

CONCLUSIONS

In the present investigation, the Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier had the positive effects on *Pennisetum glaucum* (L.) R.Br. Thus, the highest total carbohydrates, total proteins, total lipids, total phenols, total chlorophylls and total carotenoids were reported in treated with 10% SLF. The increase in the shoot length, root length, various biochemicals and pigments content at lower concentration of SLF might be due to absorption of most of the necessary elements and the presence of growth promoting hormones and nutrients in more quantities in the brown seaweed *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier. Seaweed Liquid Fertilizer can be applied to various crop plants in order to enrich the nutrient content of the soil and intern to increase the growth and yield of cultivable plants. It is also an evident from the present study that micro and macro element and plant growth regulators being supplied from the SLF alone are enough to promote the plant growth and yield of *Pennisetum glaucum* (L.) R.Br.

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