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Research Article

STUDIES ON THE EFFECT OF SEAWEED LIQUID FERTILIZER OF *SARGASSUM LINEARIFOLIUM* (TURNER) C.AG. (BROWN SEAWEED) ON *ZEA MAYS* L.

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ABSTRACT

The present study was aimed to carry out the effect of Seaweed Liquid Fertilizer (SLF) of the brown seaweed *Sargassum linearifolium* (Turner) C.Ag. on the seed germination, shoot length, root length, biochemical contents and pigment characteristics of *Zea mays* L. 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 carotenoids. The data observed from the present study showed that the Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. could be used as biofertilizer to increase the productivity of *Zea mays* L.

Keywords :-Brown Seaweed, SLF, *Sargassum linearifolium*, *Zea mays*, Biochemicals.

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INTRODUCTION

The application of seaweed concentrates has many beneficial effects on plants. Seaweed polysaccharides, which are in the place of cellulose of land plants, can be extracted readily as the products like algin, agar and carrageenan. Four avenues of economic uses of seaweeds are being currently investigated in India and they are antibiotics, bioenergy, liquid fertilizer and cultivation [1]. Seaweed meals provide an approximately equivalent amount of nitrogen, phosphorous, potassium, total salt and readily available microelements compared to other most animal manures.

Apart from macro and micronutrients seaweed contain many growth promoting hormones like cytokinin, gibberellin and auxin [2]. Seaweed extracts are known to enhance seed germination and plant growth. The total standing crop of seaweeds from intertidal and shallow waters of all maritime states and Lakshadweep islands was estimated as 91,339 tons (wet weight). The quantity of seaweeds growing in deep waters of Tamil Nadu was estimated as 75,372 tons (wet weight) in an area of 1,863 sq. km. from Dhanushkodi to Kanyakumari [3]. With this background, an experiment was conducted to study the effect of various concentrations of seaweed aqueous extracts of *Sargassum linearifolium* (Turner) C.Ag. on the growth, biochemicals and pigments of *Zea mays* L.

MATERIALS AND METHODS

Collection of sample

Sargassum linearifolium (Turner) C.Ag.

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(Figure 1) is a brown seaweed shows much attention in the recent years due to native vegetation. *Sargassum linearifolium* (Turner) C.Ag. was collected from Koothankuzhi, Tirunelveli district in the south east coast of Tamil Nadu, India during the month of January 2016. 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 [4].

Selection and Surface Sterilization of Seeds

Zea mays L. is one of the common cereals and cultivated since ancient times in India. *Zea mays* L. is grown in almost all the states of India. Therefore, *Zea mays* L. 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 [5]. 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 [6]. The surface sterilized and rinsed seeds were employed for the present study.

Preparation of Seaweed Liquid Fertilizer

Air dried *Sargassum linearifolium* (Turner) C.Ag. 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,

Percentage of Conc.	Extracts (ml)	Distilled water (ml)
Control	-	100
2.5%	25	75
5.0%	50	50
7.5%	75	25
10%	100	-

Bio Assay

Ten seeds of *Zea mays* L. 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 [7]. The same volume of extracts and distilled water were added on subsequent days on daily basis [8]. The treatments were replicated three times in a completely randomized manner. Followed by total carbohydrates [9], total protein [10], total lipid [11], total phenol [12], total chlorophyll and total carotenoids [13] were also estimated. The results obtained were tabulated and presented in the figures.

RESULTS AND DISCUSSION

Effect of Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. on Shoot and Root Length of *Zea mays* L.

The Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. was used as base for *Zea mays* L. Germination of seed was observed on 4th day and frequency of germination was found to be 100% in control and all treatments (Table 1). This treatment was resulted in stimulation of shoot and root growth. Average shoot length in control was found to be 13.16cm. The minimum stimulation of shoot length was recorded 13.89cm in 2.5% concentration of SLF (5.54%). Followed by the shoot growth was increased to 14.67cm in 5.0% (11.47%) and 15.61cm in 7.5% (18.61%). When the concentration of SLF increased to 10%, the maximum stimulation of shoot length was reached to 17.59cm (33.66%).

As shown in figure 2, the average root length in control was found to be 6.84cm. The minimum stimulation of root length was observed 7.04cm in 2.5% concentration of SLF (2.92%). Followed by the root growth was increased to 7.37cm in 5.0% (7.74%) and 7.96cm in 7.5% (16.37%). When the concentration of SLF increased to 10%, the maximum stimulation of root length was reached to 8.26cm (20.76%).

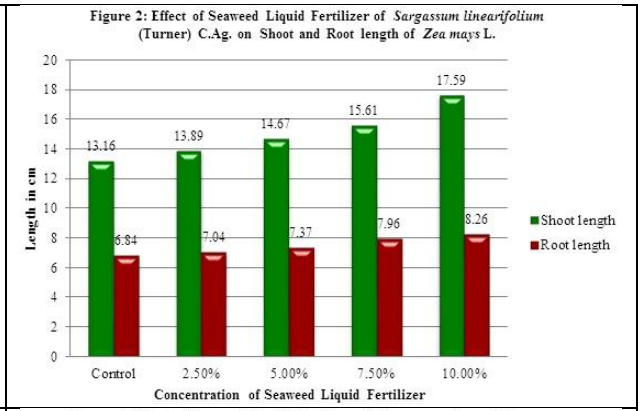
Effect of Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. on Biochemicals synthesis

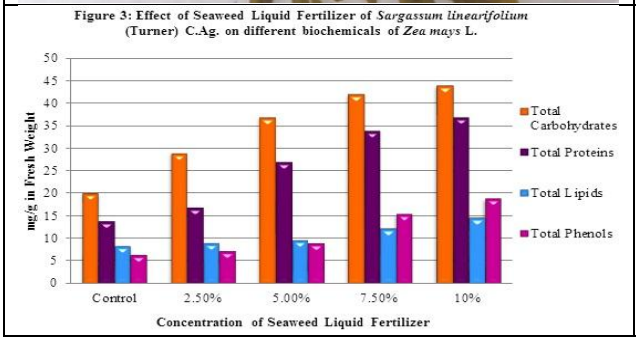
As presented in table 2 & figure 3, total carbohydrates content in control was 20.1mg/gm, followed by increasing trend of carbohydrates was observed in 2.5% (29mg/g), 5.0% (37mg/g), 7.5% (42mg/g) and 10% (44mg/gm). Total protein content in control was 14mg/gm, followed by 2.5% (17mg/g), 5.0% (27mg/g), 7.5% (34mg/g) and 37mg/gm in 10%. Total lipid in control was found to be 8.25mg/g. The amount of lipid in 2.5% was 8.94mg/g, followed by increasing trend was observed to 9.57mg/g (5.0%), 12.29mg/g (7.5%) and 14.55mg/g (10%). Total phenol content in control was 6.4g/gm, followed by increasing trend of phenols was noted in 2.5% (7.35mg/g), 5.0% (8.92mg/g), 7.5% (15.36mg/g) and 10% (18.83mg/gm).

As illustrated in figure 4, Total chlorophyll content in control was 0.421mg/gm, followed by 2.5% (0.473mg/g), 5.0% (0.528mg/g), 7.5% (0.596mg/g) and 0.611mg/gm in 10%. Total carotenoids in control were recorded to be 0.134mg/g. The carotenoids content in 2.5% was 0.148mg/g, followed by increasing trend was observed to 0.204mg/g (5.0%), 0.273mg/g (7.5%) and 0.337mg/g (10%). When the concentration of Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. was increased, all the phytochemicals content of *Zea mays* L. was also increased.

In the present study, seeds treated with lower concentration (10%) with SLF show better response in terms of shoot and root length, biochemicals and pigments. Similar observations were made by some earlier workers. Stephenson [14] recorded that lower concentration of SLF prepared from *Ascophyllum* and *Laminaria* accelerated the growth in maize. Blunden and Wildgoose [15] 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* [16]. Thirumaran *et al.*, reported with *Chaetomorpha antennina* [17] and *Rosenvingea intricate* [18] 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 [19]. 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.* [20] observed that the application of SLF of *Ascophyllum nodosum* increased the chlorophyll of cucumber cotyledons and tomato plants. Rama Rao [21] 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.

Fig-1. Natural Habit of *Sargassum linearifolium* (Turner) C.Ag.





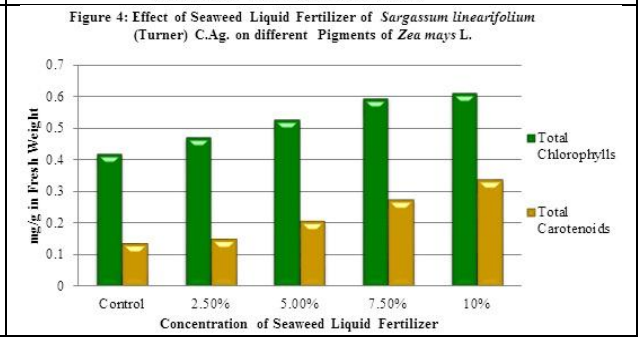


Table 1. Effect of Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. on Shoot and Root length of *Zea mays* L.

Treatment	Seed Germination (%)	Shoot Length (cm)	Increased Shoot Length (%)	Root Length (cm)	Increased Root Length (%)
Control	100	13.16	-	6.84	-
2.5%	100	13.89	5.54	7.04	2.92
5.0%	100	14.67	11.47	7.37	7.74
7.5%	100	15.61	18.61	7.96	16.37
10.0%	100	17.59	33.66	8.26	20.76

Table 2. Effect of Seaweed Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. on different Biochemicals of *Zea mays* L.

Biochemicals (mg/g)	Concentration of Plant Extracts				
	Control	2.5%	5.0%	7.5%	10.0%
Total Carbohydrates	20.1	29.0	37.0	42.0	44.0
Total Proteins	14.0	17.0	27.0	34.0	37.0
Total Lipids	8.25	8.94	9.57	12.29	14.55
Total Phenols	6.4	7.35	8.92	15.36	18.83
Total Chlorophylls	0.421	0.473	0.528	0.596	0.611
Total Carotenoids	0.134	0.148	0.204	0.273	0.337

* An average of Triplicates.

CONCLUSIONS

In the present investigation, the Seaweed Liquid Fertilizer of *Sargassum linearifolium* (Turner) C.Ag. had the positive effects on *Zea mays* L. 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 *Sargassum linearifolium* (Turner) C.Ag. 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 *Zea mays* L.

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