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INFLUENCE OF SEAWEED LIQUID FERTILIZER OF *GRACILARIA DURA* (AG.) J.AG. (RED SEAWEED) ON *VIGNA RADIATA* (L.) R. WILCZEK., IN THOOTHUKUDI, TAMIL NADU, INDIA

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ABSTRACT

The present study deals with the investigation of the effect of Seaweed Liquid Fertilizer (SLF) of the red seaweed *Gracilaria dura* (Ag.) J.Ag. on the growth, biochemical and pigment characteristics of *Vigna radiata* (L.) R. Wilczek., in Hare island, Thoothukudi, Tamil Nadu, India. The seaweed liquid fertilizer (SLF) obtained from *Gracilaria dura* (Ag.) J.Ag was treated in different concentration such as 2.5, 5.0, 7.5 and 10.0% and tested on *Vigna radiata* (L.) R. Wilczek. Among the different concentration of SLF investigated, plants that received 10% Seaweed Liquid Fertilizer showed maximum content of total carbohydrates, total proteins, total lipids, total phenols, total chlorophylls and total carotenoides compared to other concentrations. From the results obtained, it was suggested that there are considerable gain to be made increasing yield and stabilizing yield requirements for organic nutrient management appear promising.

Key words: Seaweed, *Gracilaria dura*, SLF, *Vigna radiata.*

INTRODUCTION

Seaweeds, one of the important marine living resources could be termed as the futuristically promising plants. These plants have been used as a source of food, feed and medicine in the orient as well as in the west since ancient times. Although, seaweeds in India are used for industrial production of agar, alginate and as a fertilizer, it is yet to be utilized on a large scale for various purposes which is not being done due to lack of its awareness among the Indian

population [1]. In order to harness the rich potential of seaweeds in India, the present limited use needs to be diversified into other contemporary areas of application. Being a plant of unique structure and biochemical composition, seaweed could be exploited for its multi-functional properties in the form of food, energy, medicine and cosmetics. In addition to the comprehensive view on its uses, it is in need to implement agricultural tools for sustainable management of seaweed resources [2].

Seaweeds also have been used as manure. It has been found that seaweeds contain many growth promoting substances apart from macro and micro nutrients. The use of seaweed as manure is very common in coastal areas throughout the world and particularly in France and Scotland [3]. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results have been reported. Seaweed extract is definitely capable of promoting growth in higher plants. These extracts have increased the yield of crops, seed germination, resistance to frost and fungal and insect attacks and uptake of inorganic constituents [4,5].

In the present day world the Seaweed Liquid Fertilizers are found to be more successful than the chemical fertilizers. In India large quantities of seaweeds have been utilized directly as manure or in the form of compost. Seaweed application would increase the trace elements content of the crop plants. The beneficial effects of seaweed on seed germination and plant growth have been reported by many workers [6,7,8,9,10,11,12]. The present study was aimed to find out the influence of Seaweed liquid fertilizer obtained from *Gracilaria dura* (Ag.) C.Ag., on the growth of *Vigna radiata* (L.) R. Wilczek., in Hare island, Thoothukudi, Tamil Nadu, India.

MATERIALS AND METHODS

Collection of sample

Gracilaria dura (Ag.) J.Ag. (Figure-1) is a red seaweed shows much attention in the recent years due to native vegetation. *Gracilaria dura* (Ag.) J.Ag. was collected from Hare island, Thoothukudi 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 [13].

Figure 1: Natural Habit of *Gracilaria dura* (Ag.) J.Ag

Selection and Surface Sterilization of Seeds

Vigna radiata (L.) R. Wilczek.is one of the important pulses and cultivated in almost all the states in India. Therefore, *Vigna radiata* (L.) R. Wilczek. was selected 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. 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 [13]. The surface sterilized and rinsed seeds were employed for the present study.

Preparation of Seaweed Liquid Fertilizer

Air dried plant sample was finely ground with mortar and pestle and 10gwas weighed on electronic balance. 100ml distilled water was added. The mixture was incubated for two days (48h). Thereafter, the extract was filtered through What-man 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 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 [14]. The same volume of extracts and distilled water were added on subsequent days on daily basis [15].The treatments were replicated three times in a completely randomized manner. Followed by total carbohydrates [16], total proteins [17], total lipids [18], total phenols [19], total chlorophylls and total carotenoids [20] were also estimated. The results obtained were tabulated and presented in the figures.

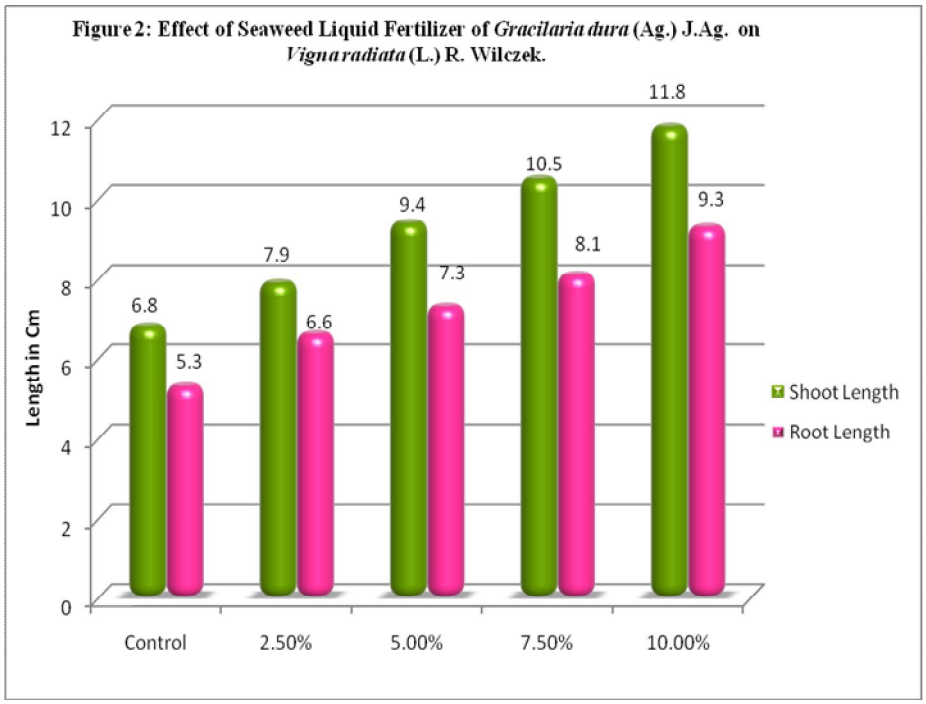
RESULTS AND DISCUSSION

Effect of Seaweed Liquid Fertilizer of *Gracilaria dura* (Ag.) J.Ag. on *Vigna radiata* (L.) R. Wilczek.

The Seaweed Liquid Fertilizer of *Gracilaria dura* (Ag.) J.Ag. was used as base for *Vigna radiata* (L.) R. Wilczek. Germination of seed was observed on 4th day and frequency of germination was found to be 100% in control and all treatments. This treatment resulted in stimulation of shoot and root growth (Table-1 & Figure-2). Average shoot length in control was found to be 6.8cm (100%). The minimum stimulation of shoot length was recorded 7.9cm in 2.5% concentration of SLF (16.17%). Followed by the shoot growth was increased to 9.4cm in 5.0% (38.23%) and 10.5cm in 7.5% (54.41%). When the concentration of SLF increased to 10%, the maximum stimulation of shoot length was reached to 11.8cm (73.52%). Average root length in control was found to be 5.3cm (100%). The minimum stimulation of root length was observed 6.6cm in 2.5% concentration of SLF (24.52%). Followed by the root growth was increased to 7.3cm in 5.0% (37.73%) and 8.1cm in 7.5% (66.03%). When the concentration of SLF increased to 10%, the maximum stimulation of root length was reached to 9.3cm (75.47%).

Table 1: Effect of Seaweed Liquid Fertilizer of *Gracilaria dura* (Ag.) J.Ag. on shoot and root length of *Vigna radiata* (L.) R. Wilczek.

Treatment	Seed germination (%)	Shoot length (cm)	Increased Shoot length (%)	Root length (cm)	Increased root length (%)
Control	100	6.8±0.09	-	5.3±0.22	-
2.5%	100	7.9±0.12	16.17	6.6±0.32	24.52
5.0%	100	9.4±0.11	38.23	7.3±0.21	37.73
7.5%	100	10.5±0.32	54.41	8.1±0.09	66.03
10%	100	11.8±0.11	73.52	9.3±0.08	75.47

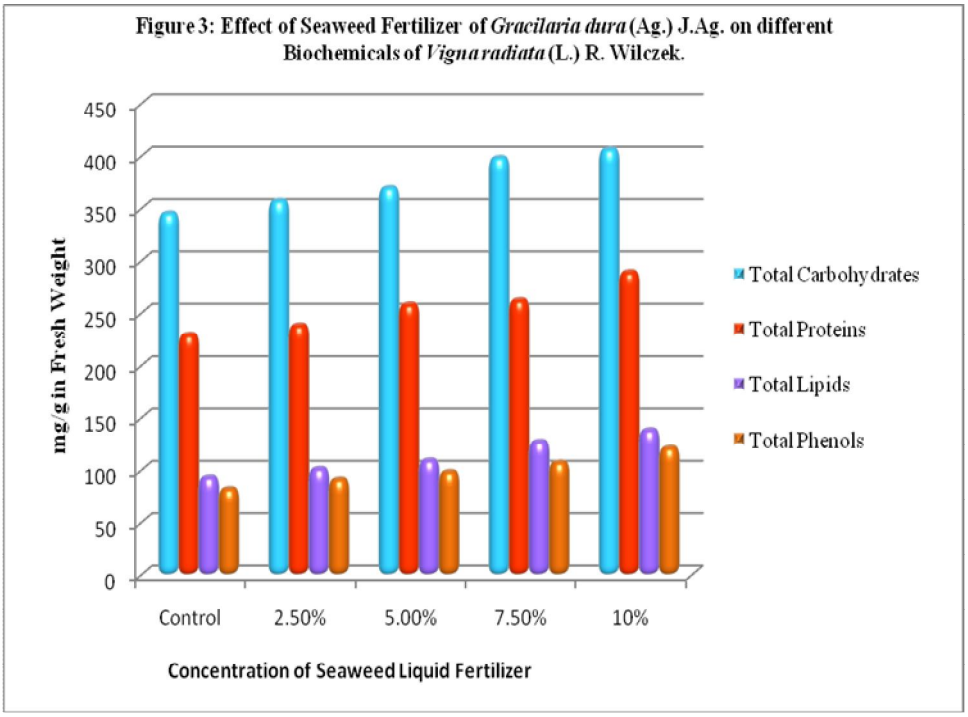


As presented in Table-2 and Figure-3, total carbohydrates content in control was 345mg/gm, followed by increasing trend of carbohydrates was observed in 2.5% (357mg/g), 5.0% (369mg/g), 7.5% (398mg/g) and 10% (406mg/gm). Total protein content in control was 229mg/gm, followed by 2.5% (238mg/g), 5.0% (258mg/g), 7.5% (262mg/g) and 289mg/gm in 10%. Total lipid in control was found to be 93mg/g. The amount of lipid in 2.5% was 101mg/g, followed by increasing trend was observed to 109mg/g (5.0%), 127mg/g (7.5%) and 138mg/g (10%). Total phenol content in control was 82mg/gm, followed by increasing trend of phenols was noted in 2.5% (91mg/g), 5.0% (98mg/g), 7.5% (107mg/g) and 10% (121mg/gm).

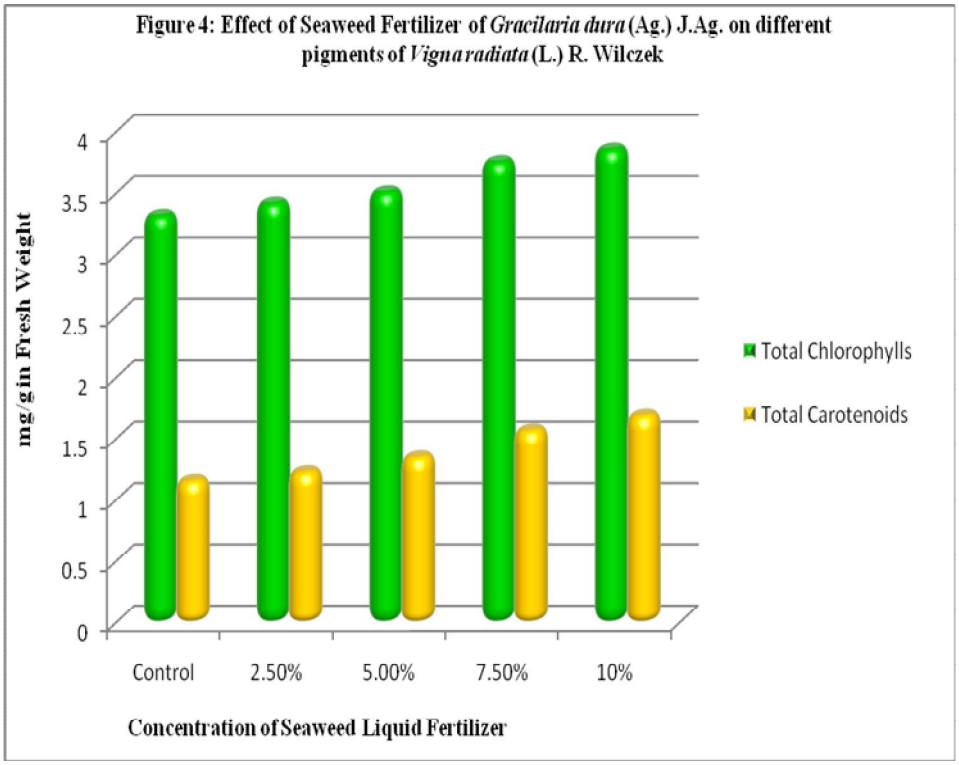
Table 2: Effect of Seaweed Fertilizer of *Gracilaria dura* (Ag.) J.Ag. on different Biochemicals of *Vigna radiata* (L.) R. Wilczek.

Biochemicals (mg/g)	Concentration of Plant Extracts				
	Control	2.5%	5.0%	7.5%	10%
Total Carbohydrates	345*	357*	369*	398*	406*
Total Proteins	229*	238*	258*	262*	289*
Total Lipids	93*	101*	109*	127*	138*
Total Phenols	82*	91*	98*	107*	121*
Total Chlorophylls	3.32*	3.42*	3.51*	3.76*	3.86*
Total Carotenoids	1.16*	1.23*	1.35*	1.57*	1.69*

* An average of Triplicates



As presented in Figure-4, total chlorophyll content in control was 3.32mg/gm, followed by 2.5% (3.42mg/g), 5.0% (3.51mg/g), 7.5% (3.76mg/g) and 3.86mg/gm in 10%. Total carotenoid in control was recorded to be 1.16mg/g. The carotenoid content in 2.5% was 1.23mg/g, followed by increasing trend was observed to 1.35mg/g (5.0%), 1.57mg/g (7.5%) and 1.69mg/g (10%). When the concentration of Seaweed Liquid Fertilizer of *Gracilaria dura* (Ag.) J.Ag. was increased, all the phytochemicals and pigments contents were also increased.



Seaweeds are the rich source of several primary nutrients like N, P, K, secondary nutrients like Ca, Mg, trace elements like Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn) and beneficial elements like Nickel (Ni), Sodium (Na) etc. Seaweed extracts stimulate various aspects of growth and development resulting in around good health of the plants while deliberating the effect of seaweed extracts on crops the aspects of root development and mineral absorption, shoot growth and photosynthesis and ultimately crop yield even vegetative propagation can also be taken into consideration [21]. Due to the presence of good amount of P in it, the Seaweed Liquid Fertilizers (SLF) proliferate root development, enhance root to shoot ratio, thereby, making the plants more able to mine adequate nutrients from the deeper layer of soil and influence crop maturity as a whole. As P is the important constituent of Nitrate reductase (NADP), the niacin component of Vitamin-B complex, helps in photosystem-I to produce NADPH.

As SLF is a very good source of K, it helps in regulating the water status of the plants, controls the opening and closing of stomata and thereby the photosynthesis to a large extent [22]. The meristematic growth, translocation of photosynthates and disease resistance are also influenced by it due to the manifestation of good impact of K. Ca being present in seaweed extracts helps in enzyme activation, cell elongation and cell stability [23]. SLF is the opulent source of secondary nutrients like Mg; hence, it helps in photosynthesis, phloem export, root

growth and nitrogen metabolism. It also influences the Nitrogen fixation in legumes as it contains Mn. Mn is a constituent of several cation activated enzymes like decarboxylase, kinase, oxidase etc., and hence, essential for the formation of chlorophyll, reduction of nitrates and for respiration [24]. The trace elements like Fe, Cu and Zn being present in considerable amount in seaweed extracts inspire redox reaction of respiration and photosynthesis, promote reduction of nitrates and sulphates and stimulate the cation activated enzymes [25]. The organic constituents of seaweed extract include plant hormones which elicit strong physiological responses in low doses. A panorama of phytohormones and plant growth regulators are found in different seaweed concentrates and marine macroalgal extracts *viz.* Auxins, Gibberellins, Cytokinins etc. which simulate rooting, growth, flower initiation, fruit set, fruit growth, fruit ripening, abscission and senescence when applied exogenously [26,27,28].

Seaweeds also contain a diverse range of organic compounds which include several common amino acids inter alia aspartic acid, glutamic acid and alanine in commercially important species. Alginic acid, laminarin and mannitol represent nearly half of the total carbohydrate content of commercial seaweed preparations [29]. Seaweeds also contain a wide range of vitamins which might be utilized by the crops. Vitamins C, B, (thiamine), B_2 (riboflavin), B_{12}, D_3, E, K, niacin, pantothenic, folic and folinic acids occur in seaweed [30]. Apart from the above organic and inorganic constituents, there is an evidence of existence of different other stimulatory and antibiotic substances [31]. Thus, being a wealthy source of versatile plant nutrients, phytohormones, amino acids, vitamins, stimulatory and antibiotic substances, the Seaweed Liquid Fertilizer enhances root volume and proliferation, biomass accumulation, plant growth, flowering, distribution of photosynthates from vegetative parts to the developing fruits and promotes fruit development, reduces chlorophyll degradation, disease occurrence etc. resulting in improved nutrient uptake, water and nutrient use efficiency causing sound general plant growth and vigour ultimately reflecting higher yield and superior quality of agricultural products.

CONCLUSIONS

Thus, it can be concluded that the Seaweed Liquid Fertilizer prepared from *Gracilaria dura* (Ag.) J.Ag., an important red seaweed is effective in increasing the growth parameters like shoot and root length, yield attributes like total carbohydrates, total proteins, total lipids, total phenols and pigments such as total chlorophylls and total carotenoids of *Vigna radiata* (L.) R. Wilczek. The saps also enhance nutrient uptake of this grain legume crop. Presence of

primary nutrients, secondary nutrients, trace elements, organic substances and plant growth regulators present in Seaweed Liquid Fertilizer of *Gracilaria dura* (Ag.) J.Ag., is responsible for the increased yield and improved nutrition of *Vigna radiata* (L.) R. Wilczek.

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