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**Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier (Brown Seaweed) on *Vigna radiata* (L.) R. Wilczek. In Koothankuzhi, Tirunelveli district, Tamil Nadu, India**

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**ABSTRACT**

The aim of the present study was to evaluate the effect of Seaweed Liquid Fertilizer (SLF) obtained using *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier collected from Koothankuzhi, Tirunelveli district, Tamil Nadu, India on seed germination, shoot length, root length, biochemicals and pigment content of *Vigna radiata* (L.) R. Wilczek. The seeds of *Vigna radiata* (L.) R. Wilczek. were treated in different concentration such as 2.5, 5.0, 7.5 and 10.0% of Seaweed Liquid Fertilizer prepared from *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier. The seed germination, shoot and root length, the biochemicals such as total carbohydrates, proteins, lipids, phenols, chlorophylls and carotenoids were increased when the *Vigna radiata* (L.) R. Wilczek. treated from 2.5% to 10% of Seaweed Liquid Fertilizer. The seed germination, shoot length, root length, biochemical and pigment content were maximum at 10% SLF.

**Keywords:** Seaweed, SLF, *Colpomenia sinuosa*, *Vigna radiata*.

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**INTRODUCTION**

In the vast marine ecosystem, several forms of life starting from unicellular to multicellular flourish, multiply and disintegrate. It is believed that the first living cell that appeared on the planet earth emerged from the ocean. In all its form, the life has developed from the growth of unicellular algae. About 90% of the species of marine plants are algae and about 50% of the global photosynthesis is derived by algae only<sup>1</sup>. The oceans provide unlimited space for capturing solar energy by marine plants through photosynthesis. Marine plants comprise of algae, sea grasses, mangroves and sand dune vegetation. The algae are of different shapes and sizes. The microscopic algae are known as phytoplankton and macroscopic ones as seaweeds. Most people come in contact with seaweeds that are washed ashore by the in coming tides. Seaweeds grow in the intertidal as well as in the subtidal area up to a certain depth where 0.1% photosynthetic light is available. They are one of the ecologically and economically important living resources of the world oceans. Being the oldest family of plants on earth, they have admirable qualities of being flexible, tenacious and prolific<sup>2</sup>.

An adequate amount of potassium, nitrogen, growth promoting hormones, micronutrients present in seaweeds make it as excellent fertilizer. Unlike chemical fertilizer, fertilizers derived from seaweeds (*Fucus*, *Laminaria*, *Ascophyllum*, *Sargassum* etc.) are biodegradable, non-toxic, non-polluting and non-hazardous to human, animals and birds. Chemical fertilizers have degraded the fertility of the soil by making it acidic, rendering it unsuitable for raising crops<sup>3</sup>. Farmers, all throughout the world are switching over to organic fertilizers. Seaweed manure besides increasing the soil fertility increases the moisture holding capacity and supplies adequate trace metals thereby improving the soil structure. This explains its worldwide use as manure along the coastal areas. Recently adopted technique, of spraying fertilizer on the plants has increased nutrient absorption efficiency in the plants. The nutrients are not leached down in to the soil but are available to the plant through leaf openings such as lenticels,

hydathods and stomata. Leaves absorb nutrients within 10 to 15 minutes of its application<sup>4</sup>. The diluted extract when sprayed on plants, show beneficial results in terms of health of plants, increase in rate of growth, resistance to pests, higher yield of 25 to 30% etc. The concept of spraying fertilizer on plants is gaining importance and many firms in India are coming forward to prepare seaweed biofertilizers<sup>5</sup>.

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<sup>6,7,8,9</sup>. The present study was aimed to find out the effect of Seaweed Liquid Fertilizers obtained from *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier collected from Koothankuzhi, Tirunelveli district, Tamil Nadu, India on the seed germination, shoot length, root length, biochemicals and pigment content of *Vigna radiata* (L.) R. Wilczek.

## MATERIALS AND METHODS

### Collection of sample

*Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier (Fig.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<sup>10</sup>.

**Fig-1. Natural Habit of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier**



### Selection and Surface Sterilization of Seeds

*Vigna radiata* (L.) R. Wilczek. is one of the common pulses and cultivated since ancient times in India. Green gram is properly indigenous to India. It is grown 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<sup>11</sup>. 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<sup>12</sup>. 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 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 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<sup>13</sup>. The same volume of extracts and distilled water were added on subsequent days on daily basis<sup>14</sup>. The treatments were replicated three times in a completely randomized manner. Followed by total carbohydrates<sup>15</sup>, total protein<sup>16</sup>, total lipid<sup>17</sup>, total phenol<sup>18</sup>, total chlorophyll and total carotenoids<sup>19</sup> were also estimated. The results obtained were tabulated and presented in the figures.

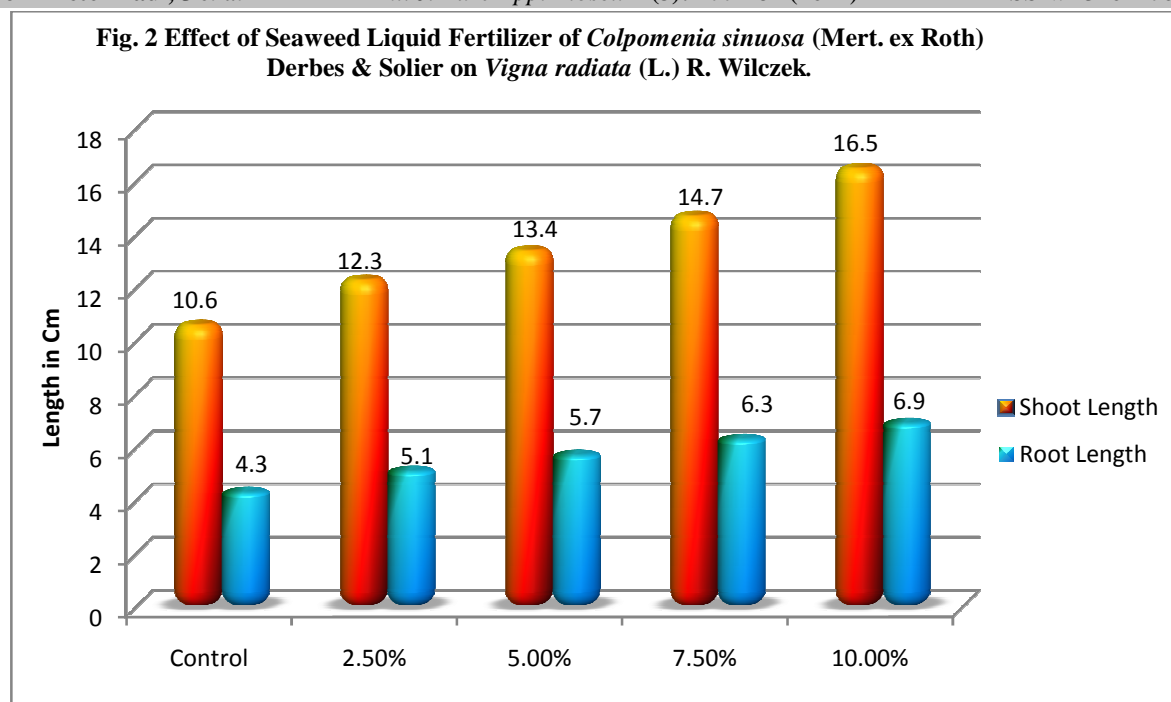
## RESULTS AND DISCUSSION

### Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on Shoot and Root Length of *Vigna radiata* (L.) R. Wilczek.

The Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier was used as base for *Vigna radiata* (L.) R. Wilczek. (Table 1). Germination of seed was observed on 4<sup>th</sup> 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 10.6cm (100%). The minimum stimulation of shoot length was recorded 12.3cm in 2.5% concentration of SLF (16.03%). Followed by the shoot growth was increased to 13.4cm in 5.0% (26.41%) and 14.7cm in 7.5% (38.67%). When the concentration of SLF increased to 10%, the maximum stimulation of shoot length was reached to 16.5cm (55.66%). Average root length in control was found to be 4.3cm (100%). The minimum stimulation of root length was observed at 5.1cm in 2.5% concentration of SLF (18.60%). Followed by the root growth was increased to 5.7cm in 5.0% (32.55%) and 6.3cm in 7.5% (46.51%). When the concentration of SLF increased to 10%, the maximum stimulation of root length was reached to 6.9cm at 60.46% (Table 1 & Fig.2).

**Table 1 Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier 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	10.6±0.12	-	4.3±0.11	-
2.5%	100	12.3±0.14	16.03	5.1±0.14	18.60
5.0%	100	13.4±0.12	26.41	5.7±0.08	32.55
7.5%	100	14.7±0.12	38.67	6.3±0.13	46.51
10%	100	16.5±0.14	55.66	6.9±0.11	60.46



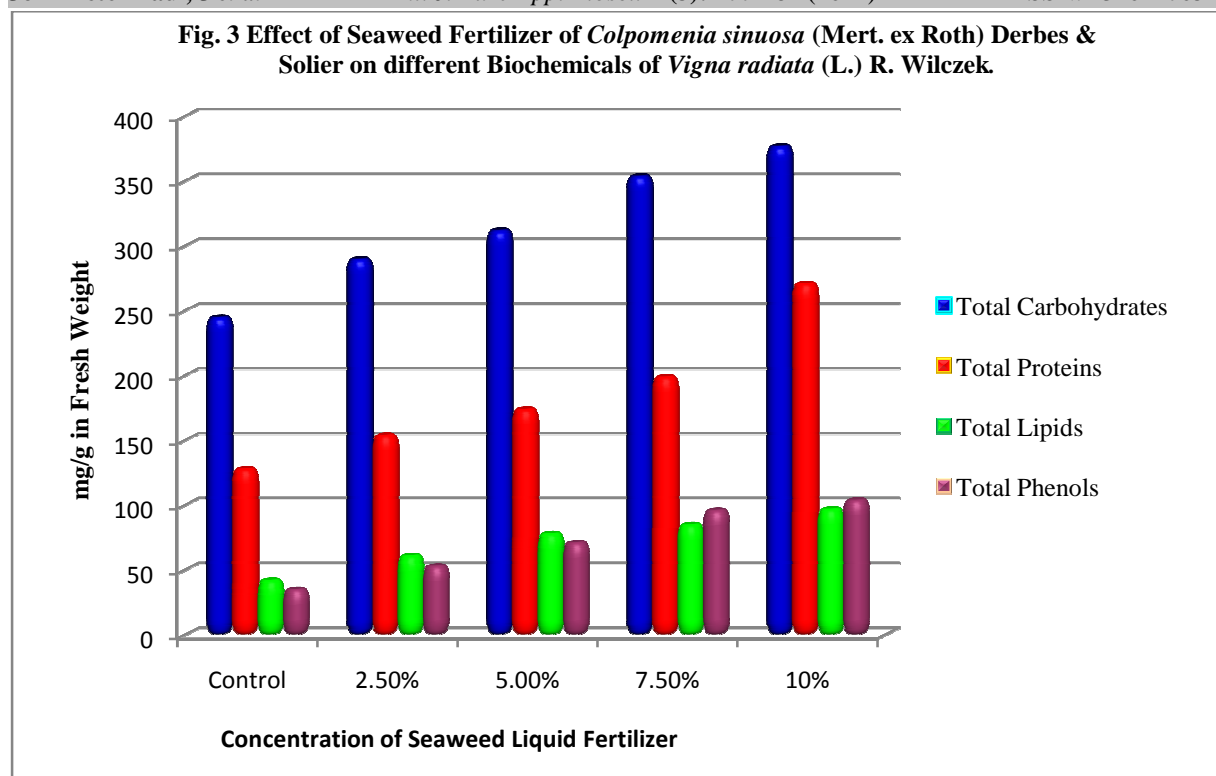
**Effect of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on Biochemicals synthesis of *Vigna radiata* (L.) R. Wilczek.**

After the treatment of various concentration of SLF on *Vigna radiata* (L.) R. Wilczek., the plants were examined for various biochemical compounds and pigments (Table 2). As shown in Fig.3, Total carbohydrates content in control was 245mg/g, followed by increasing trend of carbohydrates was observed in 2.5% (290mg/g), 5.0% (312mg/g), 7.5% (354mg/g) and 10% (377mg/g). Total protein content in control was 128mg/g, followed by 2.5% (154mg/g), 5.0% (174mg/g), 7.5% (199mg/g) and 271mg/g in 10%. Total lipid in control was found to be 42mg/g. The amount of lipid in 2.5% was 61mg/g, followed by increasing trend was observed to 78mg/g (5.0%), 85mg/g (7.5%) and 97mg/g (10%). Total phenol content in control was 35mg/g, followed by increasing trend of phenols was noted in 2.5% (53mg/g), 5.0% (71mg/g), 7.5% (96mg/g) and 10% (104mg/g).

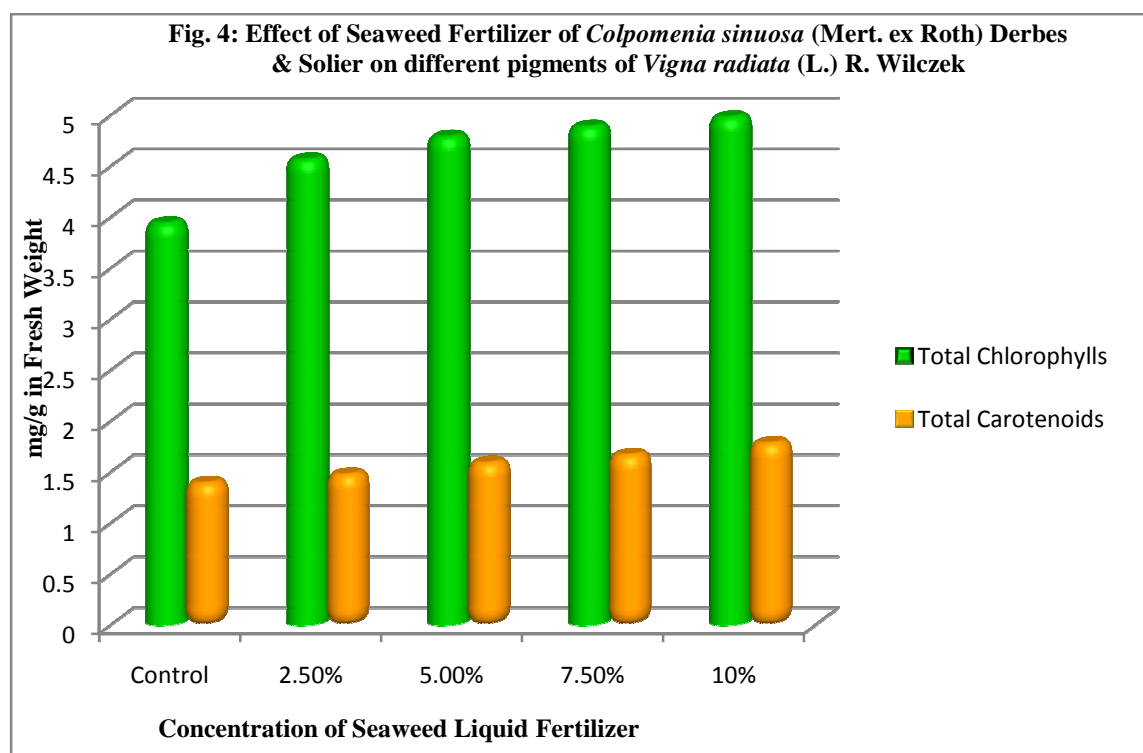
**Table 2 Effect of Seaweed Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier on different Biochemicals of *Vigna radiata* (L.) R. Wilczek.**

Biochemicals (mg/g)	Concentration of Plant Extracts				
	Control	2.5%	5.0%	7.5%	10%
Total Carbohydrates	245*	290*	312*	354*	377*
Total Proteins	128*	154*	174*	199*	271*
Total Lipids	42*	61*	78*	85*	97*
Total Phenols	35*	53*	71*	96*	104*
Total Chlorophylls	3.941*	4.567*	4.789*	4.888*	4.980*
Total Carotenoids	1.392*	1.476*	1.590*	1.667*	1.783*

\*An average of Triplicate



As presented in Fig.4, Total chlorophylls content in control was 3.941mg/g, followed by 2.5% (4.567mg/g), 5.0% (4.789mg/g), 7.5% (4.888mg/g) and 4.980mg/g in 10%. Total carotenoid in control was recorded to be 1.392mg/g. The carotenoid content in 2.5% was 1.476mg/g, followed by increasing trend was observed to 1.590mg/g (5.0%), 1.667mg/g (7.5%) and 1.783mg/g (10%). When the concentrations of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier were increased, all the phytochemical content were also increased.



From the time immemorial, seaweeds 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 India. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results have been reported. Seaweed extract is unquestionably capable of promoting growth in higher plants. These extracts have increased the yield of crops, seed germination, resistance to frost and uptake of inorganic constituents<sup>20</sup>.

Seaweed treatment of crops has grown in popularity and led to development of a large number of processed seaweed products. *Vigna catajung* when treated with 10% *Caulerpa racemosa* extract contained highest protein and amino acid contents<sup>21</sup>. Effect of Seaweed Liquid Fertilizer prepared from *Sargassum wightii* and *Hypnea musciformis* on growth and biochemical constituents of *Cyamopsis tetragonoloba*<sup>22</sup>. Growth promoting effect was observed using Seaweed Liquid Fertilizer of *Enteromorpha intestinalis* on the sesame crop plant<sup>23</sup>. Similar observations were also reported in earlier studies on proteins, total sugars and amino acids<sup>24</sup>. The increase in starch and sugars showed their close relationship and their accumulation due to SLF application. *Sorghum vulgare* with 1.5% seaweed extract prepared from *Hydroclathrus clathratus*<sup>25</sup>. Effect of Seaweed Liquid Extract of *Caulerpa scalpelliformis* on growth and biochemical constituents of *Vigna mungo* was studied<sup>26</sup>. The lower concentration of SLF of *Caulerpa scalpelliformis* (25%) enhanced the percentage of germination, shoot length, root length and biochemical constituents such as amino acids, reducing sugars, total sugar contents, and amylase activities of shoot and root<sup>27</sup>. *Arabidopsis thaliana*<sup>28</sup>, *Cajanus cajan*<sup>29</sup>, *Brassica nigra*<sup>30</sup>, *Lycopersicon esculentum*<sup>31</sup>, *Vigna radiata*<sup>32</sup> and *Triticum aestivum*<sup>33</sup>. The increased growth parameters at lower concentration may be due to the presence of higher levels of N, P, K in the seaweed extract of *Caulerpa scalpelliformis*. Sivakumar and Gandhi reported similar effect of SLF prepared from *Sargassum wightii* on *Vigna mungo*<sup>34</sup>. Significance of Seaweed Liquid Fertilizers for minimizing chemical fertilizers and improving yield of *Arachis hypogaea* under field trial<sup>35</sup>. In the same way the Seaweed Liquid Fertilizer prepared from *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier showed the positive results by increasing growth, biochemical constituents and pigments on *Vigna radiata* (L.) R. Wilczek.

### CONCLUSIONS

In conclusion, the observations on Seaweed Liquid Fertilizer treated *Vigna radiata* (L.) R. Wilczek. plants suggested that growth, biochemical characteristics and pigment contents might be promoted by micro and macro elements and growth promoting hormones present in the extract of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier. This observation is further supported by the fact that the performance of Seaweed Liquid Fertilizer of *Colpomenia sinuosa* (Mert. ex Roth) Derbes & Solier is eco-friendly, easily manageable input farming and a self-regenerating system which provide nutrients and maintains health status also. Hence the use of modern agriculture in conjunction with traditional farming practices is the sustainable solution for the future.

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