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A Study on the Potential Effects of Seaweed Liquid Fertilizer on the Germination and Growth of Asparagus Bean

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Abstract: ***The effects of the use of liquid seaweed fertiliser on Vigna unguiculata subsp. sesquipedalis growth, phytotoxicity, and productivity were evaluated in the present research. Essentially different levels of seaweed fertilizer which had been specifically treated (T0-T5) to asparagus bean and the radical length, the length of hypocotyl, the total length of the seedling, phytotoxicity, the index of growth, the index of vigour, phytomass as well as the productivity had been measured. The findings showed that the moderate level of seaweed extract supply improved the growth properties significantly. T3 possessed the highest radical (4.8 cm), hypocotyl (3.7 cm) and total seedling length (8.5 cm), higher index of vigour (8.5). Greater concentrations (T4) resulted in less efficient growth and this indicates that the response was concentration-dependent. The greatest phytomass and productivity (0.513 g and 0.0366 respectively) were observed in T1. It is an indication that seaweed fertiliser is effective at optimum concentrations to support biomass proliferation. The findings indicate that using liquid seaweed fertiliser is an eco-friendly biostimulant that can assist Vigna unguiculata subsp. sesquipedalis to grow and to produce more productively. Nevertheless, increased concentration of it may be toxic to plants. The results support the idea that agricultural systems should use the compounds of seaweeds that are sustainable to enhance the performance of plants and encourage environmental sustainability.***
Keywords: Caulerpa taxifolia, seaweed extract, biostimulant, phytotoxicity, growth index, productivity

I. INTRODUCTION

Due to the rapid population growth, the food products should become scarce as well. Most of the individuals are starving in some backward countries as they do not have food. This starvation is counterable by producing more food. In the case of the increase in food products, it can be applied to supplement the nutritional deficiencies in the developing countries. Malnutrition is posing a big threat to the third world countries such as India. It can be defeated by augmenting the efficiency of vegetables that contain a lot of protein. Numerous chemical fertilizers are currently used to raise the productivity of the vegetables. But these artificial fertilizers are immensely destroying the soil composition and soil biodiversity. Although chemical fertilizers may dramatically raise the production of food, it has an enormous impact of the environment. Therefore, it is highly desirable to come up with sustainable approach to agriculture. The most appropriate way of enhancing the agricultural production without compromising the soil is through organic fertilizers. In this regard, sea weed fertilizer can be applied successfully. Alagae that grow in the sea are known as sea weeds, particularly, numerous types of marine algae such as rockweeds, sea lettuce and dulses. The extracts of seaweed is applied as foliar spray, soil application and soaking seed before planting. Sea weed extract improve seed germination, nutrient uptake and alteration of tissue parts of plants. They also enhance resistance to fungal disease, decrease the incidences of insect attack, a higher yield among others. Liquid extract has been used in the last 40 years on a wide variety of crops. Cytokinin is also present in large quantities in seaweed extract. *Caulerpa taxifolia* refers to a species of sea weed, an algae belonging to the genus *Caulerpa* which is indigenous to the Indian Ocean. Numerous crops that are under-utilized include Asparagus bean- *Vigna unguiculata*, which can be applicable in such situations as supplementing nutritional inadequacies in the third world countries that include India particularly child malnutrition. Asparagus bean The *Vigna unguiculata subsp. sesquipedalis* is planted to be consumed as pods when they are in green color. It is normally referred to as the podded cow pea, asparagus bean, pea been etc. The key nutrients are vitamin c, vitamin B9, magnesium, manganese. It is a rapidly expanding yearly plant; it needs support in form of a trellis to grow well. So an attempt has been made to increase the productivity of The *Vigna unguiculata subsp. sesquipedalis* with the help of seaweed fertilizer made up of *Caulerpa taxifolia*.

II. MATERIALS AND METHODS

The seaweeds used in this experiment include *Caulerpa taxifolia* that belongs to the family Caulerpaceae. They were collected in Thikkodi coastline region of the Kozhikode district. The sample was thoroughly washed with sea water to remove all the unwanted contaminants, adhering sand grain and epiphytes. They were placed in plastic bags and stored in the ice box and then transported to the lab. To remove the sample surface salt we washed it with tap water whereas the excess water was removed by placing it on blotting paper.

A. Asparagus Bean

Vigna unguiculata subsp. sesquipedalis has been domesticated and grown to be consumed in the form of green pods. It is referred to as the yard long bean, asparagus bean etc. Asparagus bean are among the ancient crops that are grown since ancient times and contain soluble fibres, vitamins etc.

B. Preparation of SLF

A method that was employed to prepare SLF was outlined by Thirumaranet.al (2009). A one kilogramme portion of seaweed was cut into small fragments, ground to a fine paste and autoclaved an hour. The extract was then heated and then passed through a two-layered cloth and allowed to cool to room temperature. After that, the filtrate was centrifuged over 30 minutes. The remaining supernatant was regarded as 100 percent sea weed extract. The solution of 1, 2, 3, 4 and 5% are obtained using this extract.

The experiment was selected with 180 seeds of the asparagus bean (*Vigna unguiculatas subsps. sesquipedalis*). Each of a number of petridishes held ten seeds. In order to minimize errors, three treatments were performed routinely. One sample is sprayed with distilled water on a frequent schedule, and it is taken as a control (T0).

The sample was put under concentration of 1% (T1), 2% (T2), 3% (T3), 4% (T4) and 5%(T5) liquid fertilizer of sea weed (plate-4) was applied to samples, the percent germination was observed on the 5 th day, 10 th day and 15 th day of the experiment and other growth parameters were determined according to Erulan et.al (2009).

III. RESULT AND DISCUSSION

Table - 1. Effect of LSF on 15th (C. *taxifolia*)

	Radical length(cm)	Hypocotyl length (cm)	Seedling (cm)		Phytotoxicity	Growth index	Vigor index
To	1.5	0.5	2	50%	-	1	1
T1	1.9	0.6	2.5	80%	-26.7	1.25	2
T2	2.1	0.9	3	80%	-40	1.50	2.4
T3	4.8	3.7	8.5	100	-220	4.25	8.5
T4	6	1.2	7.2	90%	-300	3.6	6.48
T5	3	1	4	90%	-100	2	3.6

Table - 1 illustrates the different aspects under the treatment of *C.taxifolia* (LSF) on fifteenth day.The aqueous extracts of *C.taxofolia* with a low concentration (3 percent) enhanced the seedling growth (8.5cm) and the hypocotyl length was found to be 3.7 cm. The 3% sea weed extract treatment also had the higher germination percentage (100%), high growth index (4.25) (Figure-2) and high end vigor index (8.5). Phytotoxicity was -220 but that is not the minimum among the different treatments. In 3% treatment, the radicle length was 4.8 cm whereas in 4% treatment, the radicle length was higher (6cm) as compared to the 3% treatment.

In 0% treatment i.e. using distilled water as medium only 50% germination are observed. T1 and T2 treatment exhibited the same percentage germination 80%. Out of this T3 extract of *C.taxifolia*, the percentage of germination is greater in comparison to other percentages. Based on this we could arrive at the conclusion that the asparagus bean seeds wetted with low level of seaweed extract germination rates were greater whereas reducing the level of seaweed extract in the extract enhances the germination (Figure-1).

Figure-1; Germination percentage of Asparagus bean

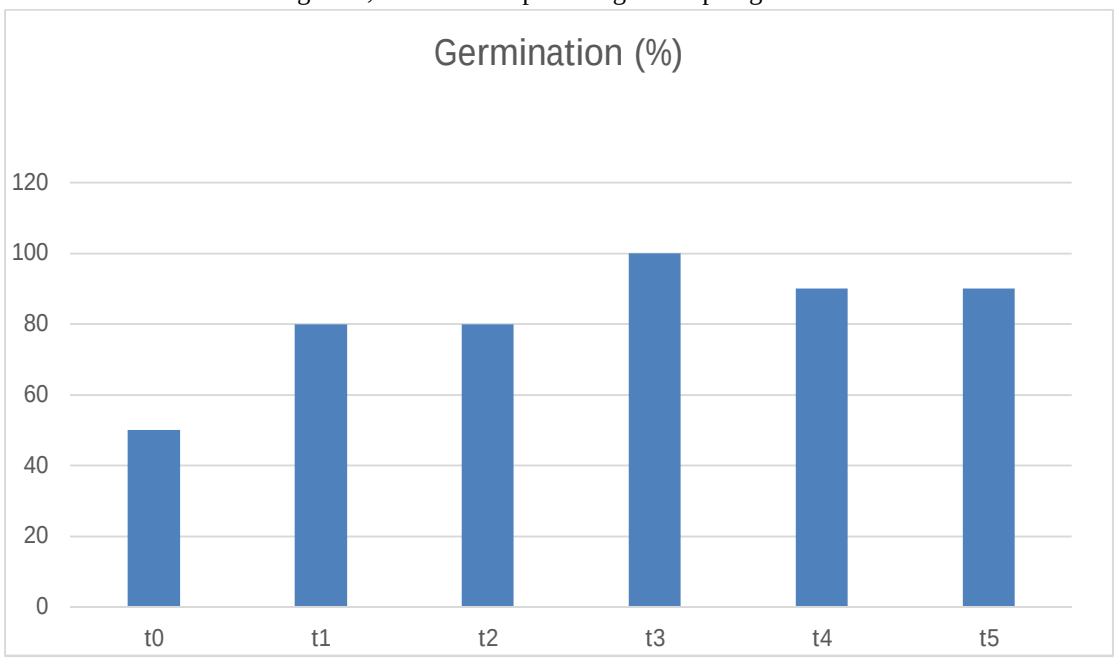

Figure-2; Growth Index of Asparagus bean

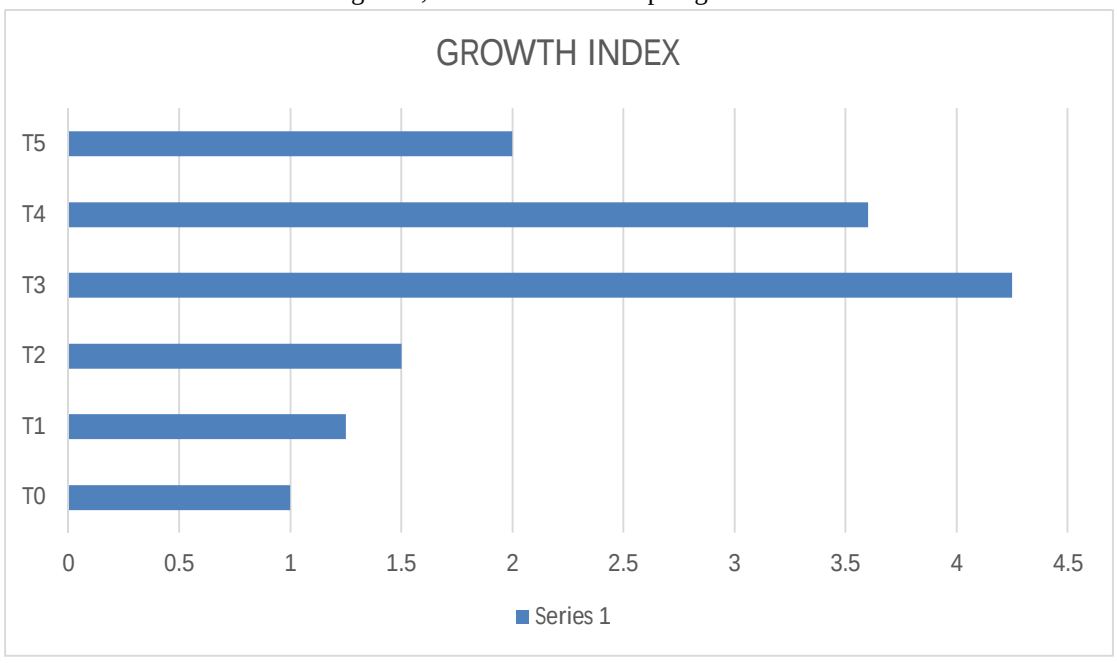

Table 2: Phytomass and productivity against C.*taxifolia* treatments

	Phytomass (gm)	Productivity
T0	0.311	0.0194
T1	0.513	0.0366
T2	0.291	0.0291
T3	0.152	0.019
T4	0.423	0.0282
T5	0.39	0.0325

In the case of phytomass 1% SLF treated *Vigna unguiculata* ssp. *sesquipedalis* produce phytomass of 0.513 gm. However, it is observed that there is little difference in the value of phytomass of treatment T0 and T5. It is also possible to add that the value of phytomass of phytomass of T3 treatment is extremely low in comparison with other treatments. In the meantime, T2 treatment exhibits 0.291gm phytomass and T4 treatment exhibits 0.423gm phytomass.

The highest productivity was found with the T1 treatment. The *Vigna unguiculata* ssp. *Sesquipedalis* T3 seedling productiveness was least productive regarding the productivity of non SLF treated seedlings. There has been a relatively similarity in the productivity between T2 and T4 in terms of their treatment (Table-2).

The use of liquid seaweed fertilizer showed a strong effect on the growth parameters, phytotoxicity and productivity of *Vigna unguiculata* ssp. *sesquipedalis*. Of the treatments, T3 (4.8 cm radical length, 3.7 cm hypocotyl length, and 8.5 cm total seedling length) showed the strongest stimulation of growth, and thus, intermediate concentrations of seaweed extract promoted physiological and morphological development. The result is consistent with the prior reports that seaweed-based biostimulants stimulate the growth of plants through improved nutrient uptake, increase enzymatic activity, and photosynthetic capacity (Khan et al., 2009; Battacharyya et al., 2015). Thirumaranet al., (2007) noted that SLF at 1.5% concentration yielded satisfactory results in (*Abelmoschus esculentus*) in terms of seed germination, fruits settling and radish length and breadth. That also indicated the biggest height (41.1 cm), amount of leaves (12) and size of the fruit (18.2 cm in length and 6.8 cm in breadth).

Interestingly, high levels of radical and hypocotyl growth were also seen with T4 (6.0 cm and 1.2 cm, respectively), however the vigor index was slightly lower (6.48) than T3 (8.5). This implies that high levels can cause phytotoxic conditions, which supports previous conclusions that over-use of seaweeds extracts can cause osmotic stress or hormonal imbalance (Rengasamy et al., 2015). The lower growth indices in T1 and T2 treatments imply that the concentration is not optimal and the focus point of both treatments is the dose-sensitive response of *C. taxifolia* to liquid seaweed fertilizer.

Similar was the case with phytomass and productivity outputs. T1 was found to have the highest phytomass, (0.513 g), and productivity (0.0366), followed by T5 (0.39 g, 0.0325), which means that intermediate fertilizer application enhanced the accumulation of biomass. It has been demonstrated that seaweed extracts are usually packed with growth-promoting agents that include cytokinins, auxins, and betaines that lead to a rise in chlorophyll content and metabolic rates (Craigie, 2011; Sharma et al., 2014). According to Ramya et al., (2011), the seaweed liquid extracts of marine algae *Stoechospermum marginatum* with low concentration (1.5%) was identified to have the highest effect on growth parameters such as shoot, root length, fresh and dry weights, leaf area and moisture content.

The research findings underscore the idea that in spite of the ability of liquid seaweed fertilizer to enhance the growth and productivity of *Vigna unguiculata Ssp. sesquipedalis* significantly, the effectiveness of the fertilizer is very sensitive to concentration. Intermediate levels (such as those found in T3) are found to improve vigor and biomass gain, also high levels (T4) can result in physiological inefficiency with stress-induced inhibition. These findings are correlated with the past studies of positive but concentration-dependent action of seaweed extracts on crops (Verkleij, 1992; Zodape et al., 2011).

IV. SUMMARY AND CONCLUSION

The current study examined the effect of the fertilizer of liquid seaweed to the growth and productivity of *Vigna unguiculatas* ssps. *sesquipedalis*. The concentrations of the seaweed extracts of T0-T5 were put to experiment to test their influence on the lengths of radicles, length of the hypocotyl, seedling length, phytotoxicity, index of vigor, and phytomass. The findings proved that seaweed fertilizer had a great impact on the physiological and morphological characteristics of *Vigna unguiculatas* subsps. *sesquipedalis*. The overall growth response of T3 was the best, meaning that moderate levels of liquid seaweed extract have the best balance of nutrients and bioactive compounds to promote plant growth.

Seaweed extracts have been found to include natural growth-promoting compounds including auxins, cytokinins, betaine and minerals, which stimulate photosynthesis, enzymatic activity, and cellular metabolism. The significant increase in the growth indices and productivity was at moderate fertilizer concentrations. Nevertheless, when the concentrations were high (T4 and over) the vigor was less and there was even a possibility of phytotoxicity implying that when it is used to the extreme it could cause imbalance in the physiological functions and also could suppress growth.

To conclude, liquid seaweed fertilizer are successfully applied as a natural biostimulant to improve the growth and production of *Vigna unguiculatas* ssps. *sesquipedalis*. The paper emphasizes on the need to optimize concentration to gain maximum benefits with less stress impacts. These results justify that marine-based biofertilizers are sustainable to be used as alternatives to the chemical inputs to ensure a healthier growth in the marine and agricultural plant systems.

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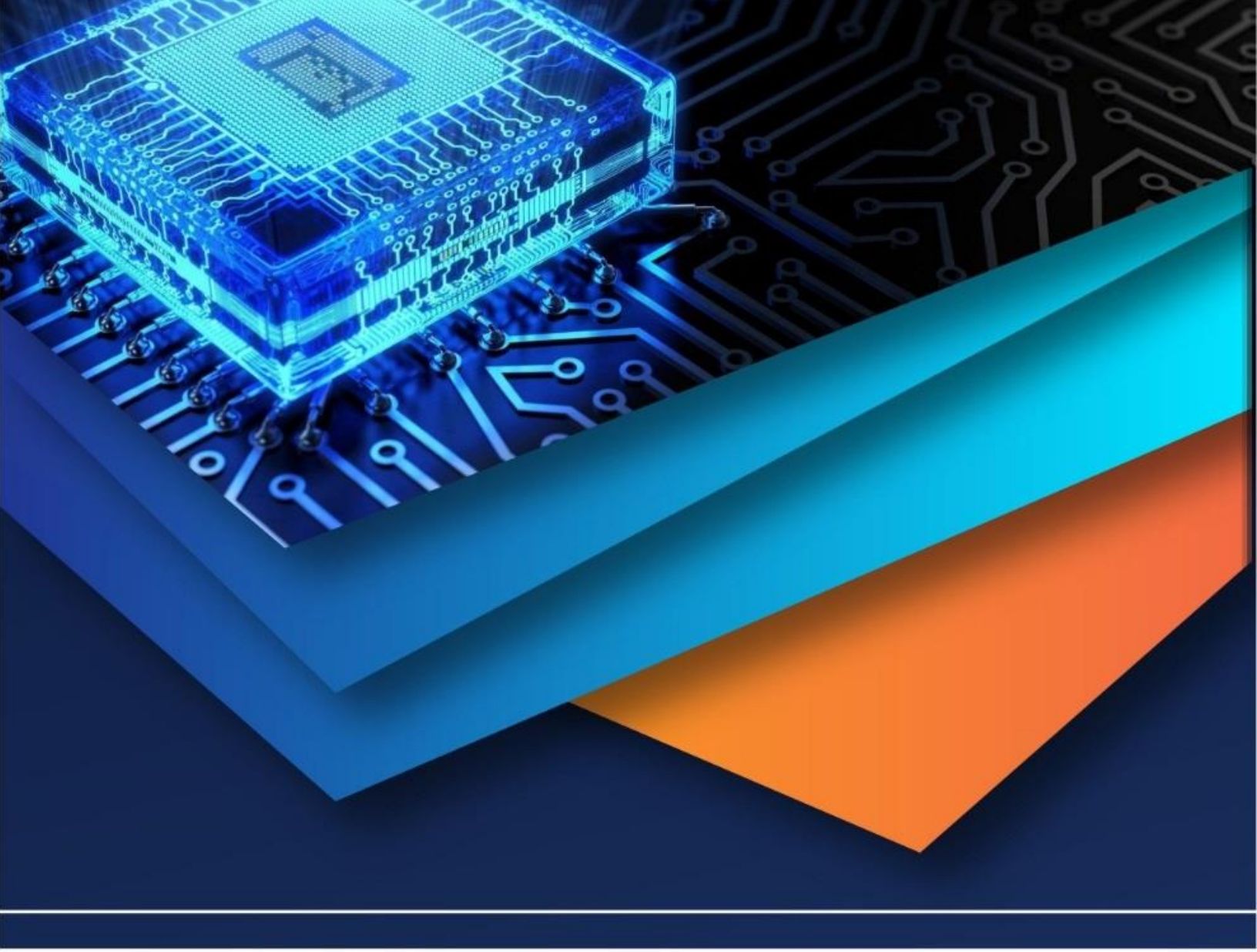

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