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# Studies on Effect of Seaweed Extracts on Crop Plants and Microbes

**Arun D , Gayathri P. K. *, Chandran M and Yuvaraj D**

**R&D lab, Department of Biotechnology, Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College,Avadi, Chennai -600 062, India**

***Corres.author: k.gayathri @velhightech.com**

**Abstract:** Seaweeds contains considerable amount of micronutrients and some plant growth hormones which helps plant growth and also in germination. When its concentration increases it will lead to toxicity and inhibits plant growth. In this present study, the effect of seaweed extract on plant germination, toxicity and the future perspective of its usage as bio fertilizer are discussed. The seaweed liquid fertilizer was prepared from three seaweeds. Seeds of *Abelmoschus esculentus and Solanum lycopersicum* were treated with seaweed extracts, which is prepared in the ratio 1:10 W/V. Seaweed extracts at different concentration is used to find out their efficiency on germination of seeds and plant growth inhibiting (toxic) concentration. The seeds treated with different concentration of seaweed extract are monitored for various parameters such as root length, shoot length and number of lateral roots. The results showed increased germination and growth on low concentration, but when the concentration increases, it inhibits the rate of germination due to its toxicity in *Solanum lycopersicum*. All the three seaweed extract showed better rate of germination at optimum concentration ranges between 40 - 60% in *Abelmoschus esculentus* and toxicity at higher concentration. Extracts of all the three seaweeds didn't show any antibacterial activity against five bacterial species.
**Keywords**: Fertilizer, Seaweeds, Germination, Toxicity.

## Introduction

The use of seaweeds as manure in farming practice is very ancient and common practice among the Romans and also practiced in Britain, France, Spain, Japan and China. The use of marine macro algae as fertilizer in crop production has a long tradition in coastal areas all over the world [1]. Seaweed cast continued to be so valuable to farmers, even in the early 1900s [2]. Seaweed extract is a new generation of natural organic fertilizers highly nutritious and promotes faster germination of seeds and increase yield and resistant ability of many crops [3]. Seaweeds are rich in micro and macro nutrients [4]. Micronutrients are toxic to both plants and animals in high concentrations. The increased in micro and macronutrient in soil by fertilizers may also have negative impact on plant growth [5]. Too much of Nitrogen will results in excessive foliar growth at the expense of flowering and fruit production. Phosphorus generally has little or no effect and it may induce micronutrient deficiencies with extreme excess. Potassium often results in "burning" of leaves around the edges. Calcium generally associated with high pH, which results inmicronutrient deficiencies. Magnesium may interfere with Ca uptake. Boron leads to death of interveinal tissues of leaves [6]. The toxicity of any seaweed liquid fertilizer will results in inhibited plant growth and abolishing of native symbiotic and non-symbiotic microorganisms present in the soil, for improving the fertility of the soil by natural process [7]. Hence it is very important to study the toxic effect of over utilization of fertilizer in agricultural land on crop plant and microorganisms for

increased production, fertility and continuous natural cycles. This study is to optimize the concentration of seaweed liquid fertilizer, its effect on plant germination on two different crop plants and its antibacterial activity against five different bacterial species at different concentration levels.

## Materials and Methods:

### Collection and Identification of Seaweeds

Fresh seaweeds used in the present study were collected from Pulicat Lake, Tamilnadu, India, during December 2013. They occur in all seasons. They were hand-picked and washed thoroughly with seawater to remove all the unwanted impurities, adhering sand particles, epiphytes etc. It is then packed in a plastic bag and transferred to the lab. In lab the collected seaweeds were again washed in fresh water to remove the surface salt and then blotted to remove excess water. The seaweeds were segregated and under gone taxonomical identification, and identified as *Gracilaria edulis* – a red seaweed, *Enteromorpha intestinalis* and *Chaetomorpha linum* – Green seaweeds.

### Preparation of Seaweed Liquid Fertilizer

Fresh seaweeds were washed thoroughly to remove all epiphytes and sand particles with tap water. Shade dried for five days and the sample was ground or cut in to pieces. The coarse powder was mixed with distilled water in ratio of 1:20 (w/v). Boiled for 60 minutes and filtered through four fold of white cloth. The filtrate was collected and stored. The filtrate thus obtained is considered as 100% [8]. Five different concentrations of solutions such as 20%, 40%, 60%, 80% and 100% were prepared and used for the study.

### Selection of Test Plants

The test plants, selected for the present study was *Abelmoschus esculentus* commonly known as Lady Finger which is a simple dry fruit and *Solanum lycopersicum* commonly known as Tomato which is a simple fleshy fruit. The seeds were bought from Seed Works India Private Limited. The seeds with uniform size, colour and weight were chosen for the experimental purpose.

### Effect of Seaweed Liquid Fertilizer on Plant Germination

Seeds of both *Abelmoschus esculentus* and *Solanum lycopersicum* were treated with 3 different seaweed liquid fertilizers as described elsewere [9]. Petri plates were sterilized to avoid spoilage of seeds, and then filter paper was placed to provide support and hold moisture for the germination of seeds. Each plate is placed with three seeds of *Abelmoschus esculentus* and *Solanum lycopersicum* respectively. Five different concentrations (20, 40, 60, 80, 100) of seaweed liquid fertilizer is poured on each plate with respect to the seaweed and seeds. The seeds were placed over filter paper and then, these were incubated at room temperature. The plates were kept separately with 12 hours of dark and 12 hours of light. The seeds were monitored for germination after three days and the growth of the seedlings were observed after a period of one week from the day of treatment. After the observation of germination and growth of seedlings in the plate which were treated with different concentration of liquid fertilizers, various parameters such as number of leaves, height of the shoot, length of the root, number of lateral roots were measured. A plate with water instead of liquid fertilizer is kept as control.

### Antibacterial Activity of SLF

The antibacterial assay was done by both disc diffusion and Agar well diffusion method in nutrient agar [10]. The activities of all the SLF were tested against five bacterial species such as *Enterococcus hirae, Pseudomonas aeruginosa, Acetobacter mofti, Escherichia coli and Bacillus cereus.*

## Results and Discussions

### Germination of *Abelmoschus esculentus* (okra) seeds treated with SLF's

The (Figure- 1 & 2(graph 1 &2)) is plotted between root length and shoot length of germinated seedlings at different concentrations and numbers in centimeter. The graph: 1 showed good rate of germination in okra seeds from 20 to 60 % concentration of *G. edulis*. At 40 %, it showed increased number of lateral roots while germination. At 60% concentration all the parameters were good when compared to other concentration.

The SLF prepared from *E. intestinalis* did not have considerable effect on the germination of okra seeds. The graph showed different concentrations of *C. linum* SLF had gradual increase in all the parameters of okra seeds from 40% to 80%, but at 20 % it showed no root and shoot development.

**Figure 1: *Abelmoschus esculentus* seeds treated with different concentration of *G. edulis* (1), *E. intestinalis* (2) and *C. linum* (3) (A) 20% SLF (B) 40% SLF (C) 60 % SLF (D) 80% SLF (E) 100% SLF.**

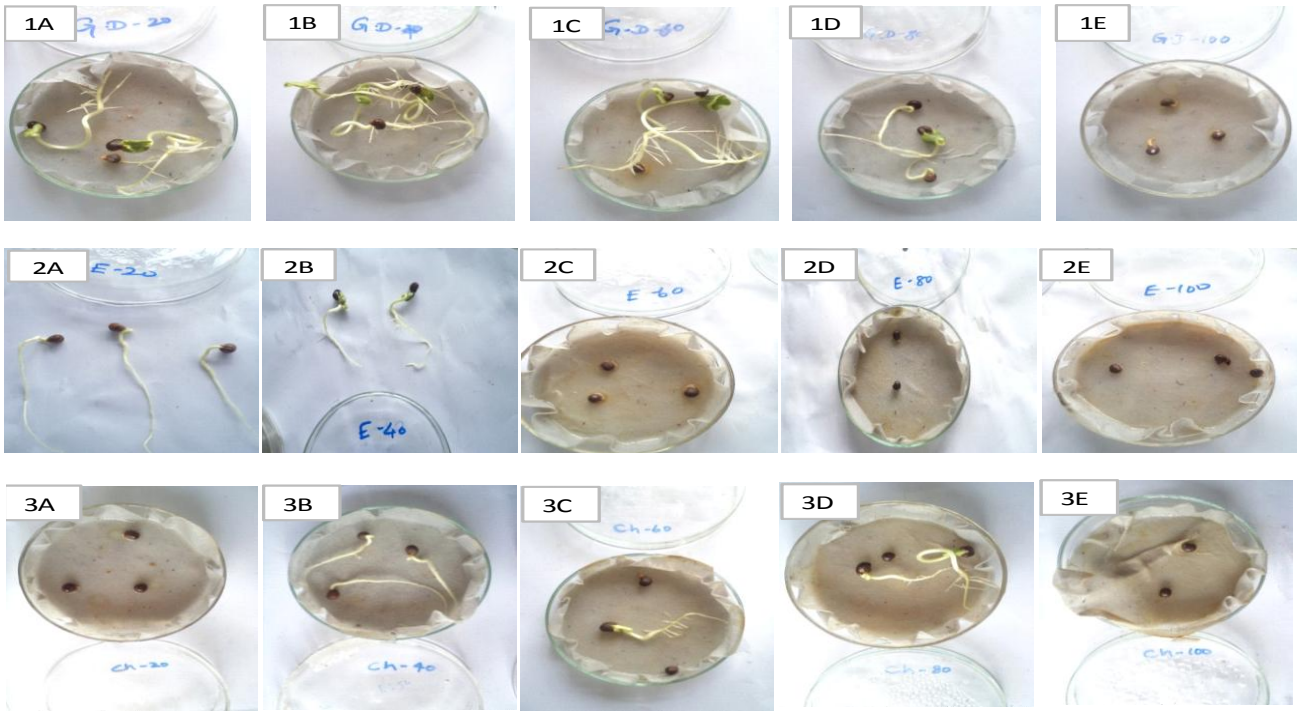
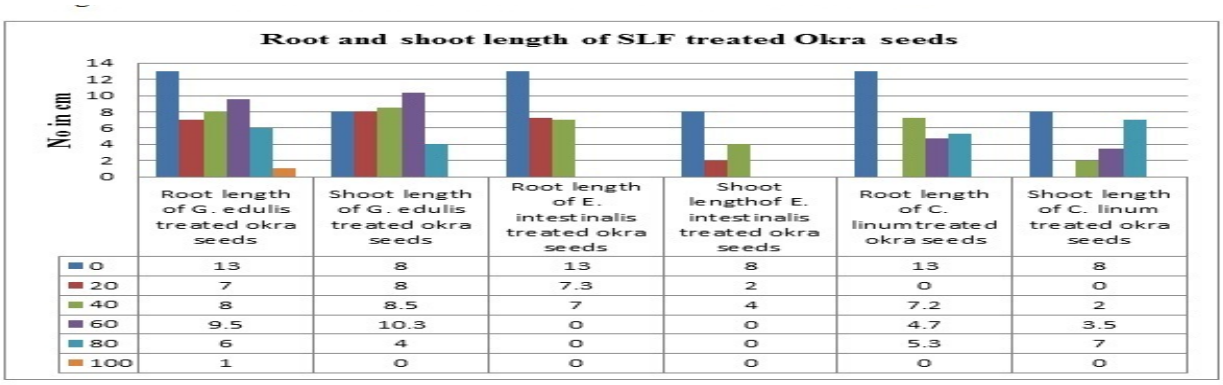
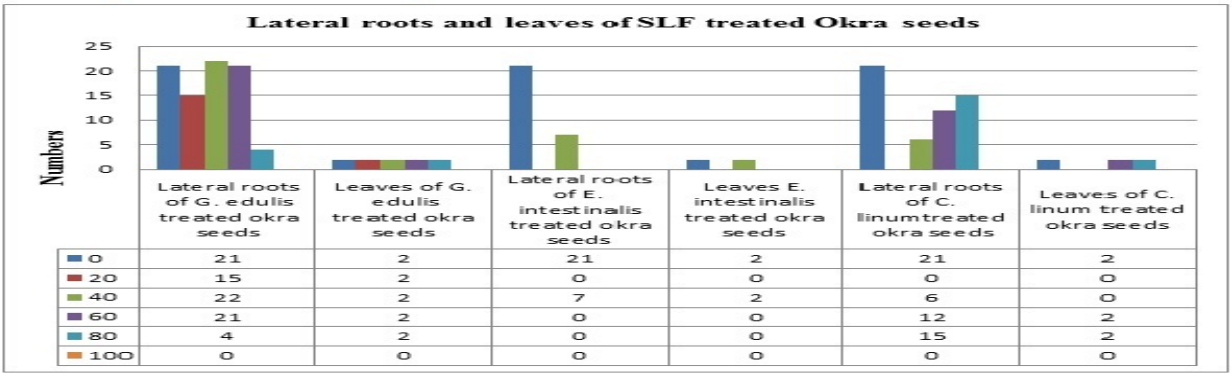



**Figure 2: Graphical representation depicting the growth of *Abelmoschus esculentus***




| | Root length of G. edulis treated okra seeds | Shoot length of G. edulis treated okra seeds | Root length of E. intestinalis treated okra seeds | Shoot lengthof E. intestinalis treated okra seeds | Root length of C. linumtreated okra seeds | Shoot length of C. linum treated okra seeds |
|---|---|---|---|---|---|---|
| 0 | 13 | 8 | 13 | 8 | 13 | 8 |
| 20 | 7 | 8 | 7.3 | 2 | 0 | 0 |
| 40 | 8 | 8.5 | 7 | 4 | 7.2 | 2 |
| 60 | 9.5 | 10.3 | 0 | 0 | 4.7 | 3.5 |
| 80 | 6 | 4 | 0 | 0 | 5.3 | 7 |
| 100 | 1 | 0 | 0 | 0 | 0 | 0 |

Graph 1: Root and shoot length of SLF treated *Abelmoschus esculentus* seeds




| | Lateral roots of G. edulis treated okra seeds | Leaves of G. edulis treated okra seeds | Lateral roots of E. intestinalis treated okra seeds | Leaves E. intestinalis treated okra seeds | Lateral roots of C. linumtreated okra seeds | Leaves of C. linum treated okra seeds |
|---|---|---|---|---|---|---|
| 0 | 21 | 2 | 21 | 2 | 21 | 2 |
| 20 | 15 | 2 | 0 | 0 | 0 | 0 |
| 40 | 22 | 2 | 7 | 2 | 6 | 0 |
| 60 | 21 | 2 | 0 | 0 | 12 | 2 |
| 80 | 4 | 2 | 0 | 0 | 15 | 2 |
| 100 | 0 | 0 | 0 | 0 | 0 | 0 |

Graph 2: Number of Lateral roots and leaves of SLF treated *A. esculentus* seeds

**Germination of *Solanum lycopersicum*(Tomato)seeds treated with SLF's**

**Figure 3: *Solanum lycopersicum* treated with different concentration of *G. edulis* (4), *E. intestinalis* (5) and *C. linum* (6) (A) 20% SLF (B) 40% SLF (C) 60 % SLF (D) 80% SLF (E) 100% SLF**

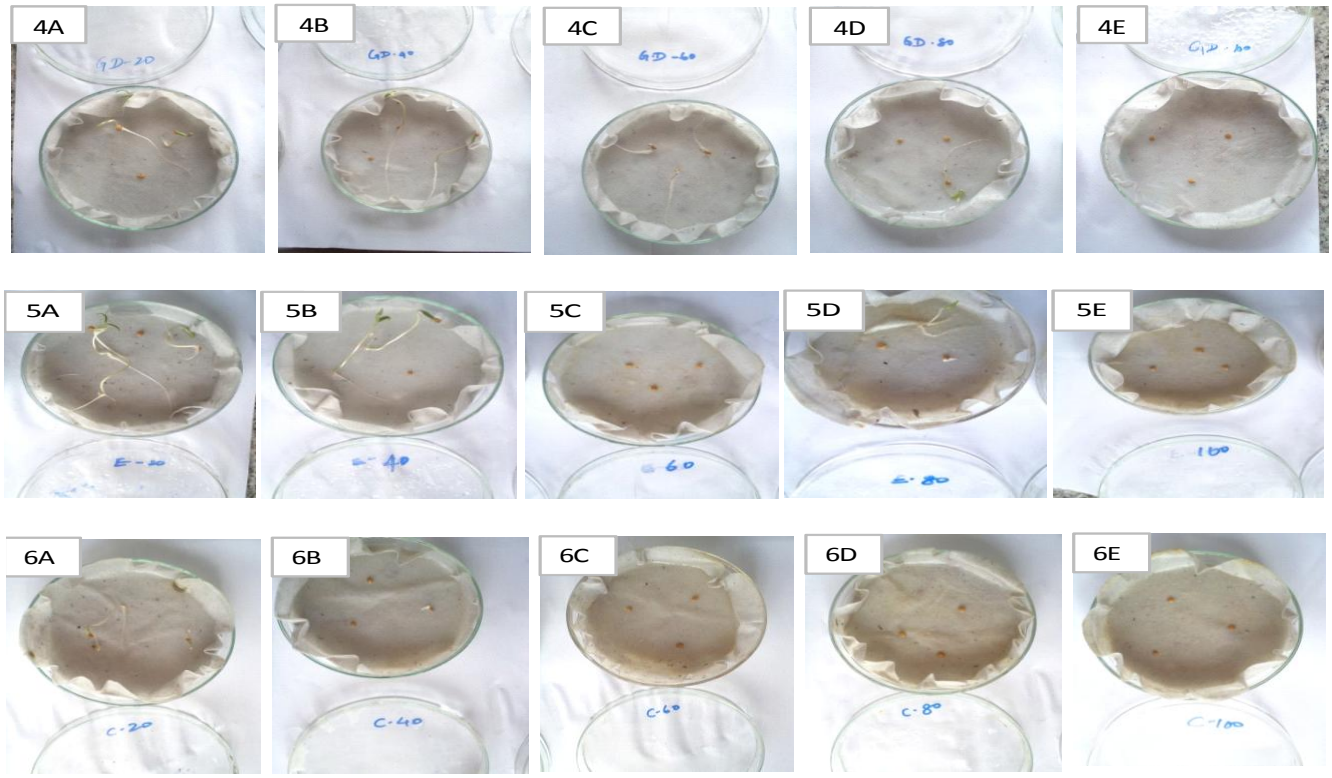
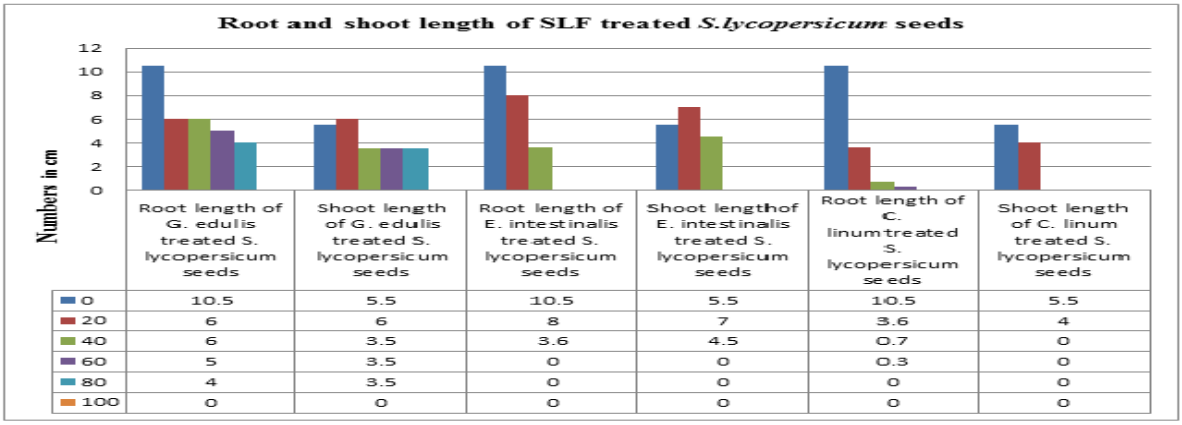
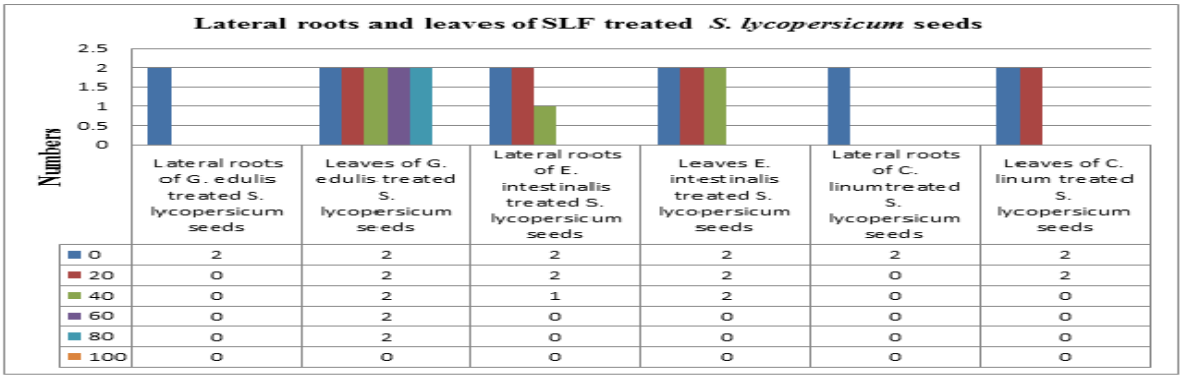



**Figure 4: Graphical representation depicting the growth of *S. lycopersicum***




| | Root length of G. edulis treated S. lycopersicum seeds | Shoot length of G. edulis treated S. lycopersicum seeds | Root length of E. intestinalis treated S. lycopersicum seeds | Shoot lengthof E. intestinalis treated S. lycopersicum seeds | Root length of C. linumtreated S. lycopersicum seeds | Shoot length of C. linum treated S. lycopersicum seeds |
|---|---|---|---|---|---|---|
| 0 | 10.5 | 5.5 | 10.5 | 5.5 | 10.5 | 5.5 |
| 20 | 6 | 6 | 8 | 7 | 3.6 | 4 |
| 40 | 6 | 3.5 | 3.6 | 4.5 | 0.7 | 0 |
| 60 | 5 | 3.5 | 0 | 0 | 0.3 | 0 |
| 80 | 4 | 3.5 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | 0 |

Graph 3: Root and shoot length of SLF treated *S. lycopersicum* seeds.




| | Lateral roots of G. edulis treated S. lycopersicum seeds | Leaves of G. edulis treated S. lycopersicum seeds | Lateral roots of E. intestinallis treated S. lycopersicum seeds | Leaves E. intestinalis treated S. lycopersicum seeds | Lateral roots of C. linumtreated S. lycopersicum seeds | Leaves of C. linum treated S. lycopersicum seeds |
|---|---|---|---|---|---|---|
| 0 | 2 | 2 | 2 | 2 | 2 | 2 |
| 20 | 0 | 2 | 2 | 2 | 0 | 2 |
| 40 | 0 | 2 | 1 | 2 | 0 | 0 |
| 60 | 0 | 2 | 0 | 0 | 0 | 0 |
| 80 | 0 | 2 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | 0 |

Graph 4: Number of Lateral roots and leaves of SLF treated *S. lycopersicum* seeds

(Figure- 3 & 4 (graphs 3 & 4)), showed good results in tomato seeds at 20% concentration of *G. edulis* when compared to increase in concentration level. There was a decline in the graph with respect to the increase in concentration of SLF. It showed germination in seeds up to 40% concentration and no growth found at higher concentration. At 20% concentration SLF of *E. intestinalis* showed, there is an increased shoots and root growth. SLF of *C. linum* showed some root and growth development. On increasing concentration, root length was decreased and no other parameters were seen.

*C. linum* is good for okra seeds at high concentration, but in tomato it is good only at lower concentration. *C. linum*, E. *intestinalis* and *G. edulis* showed better results at lower concentration in tomato seeds. On comparing the whole, three seaweed liquid fertilizers on two different seeds showed change in growth rate and various parameters in germination. In okra seeds *E. intestinalis* showed increased rate of germination up to 40%, *G. edulis* showed increased growth up to 60%, and *C. linum* showed good rate of germination up to 80%. But after that suddenly it showed zero rate of germination in next concentration levels. All the three seaweeds *G. edulis*, *E. intestinalis* and *C. linum* has more toxic effect on tomato plant when compare to okra, when its concentration increases. They showed good results at lower concentration. Hence SLF shall be used at very high dilution rate in agricultural field for increased plant germination and growth in tomato seeds. And for okra seeds SLF shall be used at moderate dilution rate.

### 3.3. Antibacterial Activity

The extracts were tested against gram positive and gram negative bacteria in agar well diffusion and disc diffusion method. All the three seaweeds did not showed any effect on growth of both gram positive and gram negative bacteria. Hence it denoted that, it has no effect on growth of microorganisms at any concentration level. From this it is concluded that, it is not harmful to the native microorganisms present in the soil, which helps in enrichment of fertility in the soil without affecting its native helpful bacteria and microorganism.

The results showed that there is an increase in rate of germination of seeds at lower concentration and it reduces at higher concentration. Similar results were obtained [7] on *Abelmoschus esculentus* by 10% SLF of *Sargassum myryocystem.* SLF of *Dictyota dichotoma* was found effective in increasing the growth of roots and shoots, number of roots at lower level concentration [11]. Similar observations were made in *Cajanus cajan* [8]. In this study lower concentration of seaweeds extracts showed increased germination with respect to their species and seeds of crop plant. Similar results were obtained by differential response to the seaweed extract treatment on *Cajanus cajan* [8]. The highest concentrations exhibit lower seed germination and the lowest concentration showed higher seed germination. *Vigna catajung* and *Dolichos biflorus* showed a considerable increase of amino acid due to SLF of *Caulerpa racemosa* and *Gracilaria edulis* 10% level [12,13]. The low concentration (20%) of aqueous seaweed extract promoted seedling growth. The seed germination, shoot length, root length, number of lateral roots was found maximum at 20% SLF with or without chemical fertilizer [14]. Seaweed extract didn't inhibit the growth of native microorganisms and inoculated bio fertilizers, Liquid fertilizers derived from seaweeds are found to be superior to chemical fertilizers.

## Conclusion

Seaweed extract which gave better results at lower concentration shall be utilized at very high dilution rate in agricultural field to enhance the rate of germination of seeds. It will not affect native useful microorganisms present in soil.

## References

1. Fleurence, J. Seaweed proteins: biochemical nutritional aspects and potential uses. Trends in Food Science and Technology. 1999. 10, 25–28.
2. Verkleij, F.N. Seaweed extract in agriculture and horticulture-A review. Biology of Agriculture and Horticulture, 1992, 8: 309-334.
3. Dhargalkar VK, Pereira N, and Seaweed: promising plant of the millennium, Sci. Cult., 2005, 71, 60-66.
4. Chapman V.J. and Chapman D.J, Seaweeds and their uses. 3rd edition, Chapman and Hall. London Newyork. 1980: 30-42.
5. Bennett, W.F. Nutrient Deficiencies and Toxicities in Crop Plants. St. Paul, MN. APS Press. 1993, 202.

6. Guiry, M. D. and Blunden, G. Agricultural uses of seaweeds and seaweed extracts. In: Seaweed Resources in Europe: Uses and Potential. Seaweed resources in Europe: uses and potential. 1991. 65-81.
7. Balamurugan.G. Effect of Seaweed Liquid Fertilizer of Sargassum myryocystem of Abelmoschus esculentus (L.). International Journal of Current Research and Development, 2013, 1(1), 33-37.
8. Mohan, Venkataramankumar V.R., Murugewari R and Muthuswami M, Effect in *Cajanus cajan* of Crude and commercial seaweed extract on seed germination and seeding growth in cajan L. *Phykos*. 1994, 33(1&2): 47-51.
9. Sridhar. Effect Of Seaweed Liquid Fertilizer (Slf) On The Germination And Growth Of Seedling Of Some Agricultural Crops. International Journal of Recent Scientific Research. 2011, 2(12), pp. 287 - 291.
10. Erulan.V, P. Soundarapandian, G. Thirumaran and G. Ananthan, 2009, Studies on the effect of *Sargassum polycystum* extract on the growth and biochemical composition of *Cajanus cajan* (l.) Mill sp. American-eurasian j. Agric. & environ. Sci., 6 (4): 392-399.
11. Sasikumar K, Govindan T, Anuradha C. Effect of Seaweed Liquid Fertilizer of *Dictyota dichotoma* on growth and yield of *Abelmoschus esculantus* L. European Journal of Experimental Biology, 2011, 1 (3):223-227.
12. Anandharaj M and Venkatesalu V, Effects of seaweed liquid fertilizer on *Vigna catajung*. *Seaweed Research and Utilization* 2001, 23 (1&2): 33–39.
13. Anandharaj and Venkatesalu, 2001. Studies on the effect of seaweed extract on *Dolichos biflorus*. Seaweed Research and Utilisation Association, 24(1): 129-137.
14. Thirumaran G, Arumugan M, Arumugam R, Anantharaman P., 2009. Effect of seaweed liquid fertilizer on growth and pigment concentration of Abelmoschus esculentus (I) Medikus. Am Eurasian J Agron 2: 57-66.

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