

Influence of Seaweed Extract of *Gracilaria Textorii* and *Turbenaria Arnata* on the Germination, Growth and Yield of Some Vegetable Crops

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ABSTRACT

Seaweed and its derived products are used as fertilizer in the coastal areas throughout the globe. Any improvement in the agriculture system that results in higher production should reduce the native environmental impact of agriculture and enhance the sustainability of the system. The present study investigation reveals that the effect of liquid fertilizer (SLF) of *Gracilaria textorii* and *turbenaria arnata* applied as a foliar spray (2.5%, 5%, 10%, 20% concentrations) on Brinjal, Chilly. Growth and yield of plants as well as quality of product was greatly influenced by application of SLF. The effect of Seaweed Liquid Fertilizer (SLF) of *Gracilaria textorii* and *turbenaria arnata* on seed germination, growth and yield parameters such as number of leaves, weight of fruits in crop plants such as Brinjal and Chilly were examined. The Seaweed Liquid Fertilizer was found to be effective in increasing the growth and yield in low doses (2.5% and 5%) than the control and higher concentrations of seaweed Liquid fertilizer. Recent seaweed extracts as liquid fertilizers has come in the market for a simple reason that they contain many growth promoting hormones like auxins, gibberellins, trace elements, vitamins, amino acids and micro nutrients. The seaweed extract was found effective in increasing the biomass growth of roots and shoots, number of leaves, flowers and fruits, maturity time and yield.

Key words: seaweed liquid fertilizer, SLF, foliar spray, germination, growth, yield.

INTRODUCTION

Seaweeds or macro algae are aquatic plants belonging to the thallophyta of plant kingdom. Seaweeds are rich in minerals, protein, lipid, carbohydrate, vitamins, bromine, iodine etc. So algae have been harvested by man for centuries particularly in Japan and China where they form a part of the staple food. In recent years, seaweed extracts as liquid

fertilizers have come in market. Recent researches have proved that SLF is better than other chemical fertilizers^{8,12,14,16}. Seaweeds have recently gained importance as foliar sprays for several crops^{2,13,17} because the extract contains growth promoting hormones (IAA and IBA), cytokinins, trace elements, vitamins and amino acids⁴.

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The growing population is facing pressure on food production and to meet the increasing demand, farmers are using chemical fertilizers to enhance their crop production. Chemical fertilizers mixed with pesticides get accumulated in plants which lead to health problems in human due to bio – magnification⁹ Seaweeds are important marine renewable resources. They are used as food, feed, fodder, fertilizer, agar, alginate, carrageenan and source of various fine chemical¹⁵. In recent years, the use of natural fertilizer¹⁰ has allowed for substitution in place of conventional synthetic fertilizer⁷. Seaweeds contain all the trace elements and plant growth hormones required by plants. It was also reported that seaweed manure is rich in potassium but poor in nitrogen and phosphorus then the farm manure¹¹. There are many plant growth hormones, regulators and making the backbone of our economy. The fast growing promoters available to enhance yield attributes^{5,6,7}. Population is mounting tremendous pressure in food production. Seaweed liquid fertilizers will be useful for achieving production in the country. To meet out this increasing demand, farmers use chemical fertilizers to enhance the crop production. The extract contains growth promoting hormones (IAA and IBA), toxic chemicals (arsenic and Cytokinins, Gibberellins, trace elements, vitamins, cadmium) from the chemical fertilizers accumulate in aminoacids, antibiotics and micronutrients³.

MATERIAL AND METHODS

Study area:

Visakhapatnam lies on the East coast of India between latitudes $17^{\circ} 14' 30''$ and $17^{\circ} 45'$ and longitudes $83^{\circ} 16' 25''$ and $83^{\circ} 21' 30''$ E with vast resources of marine algal species. Marine red algae such as *Gracilaria textorii* and *turbenaria arnata* were collected from the Visakhapatnam Coast.

Collection of sample:

The seaweed sample *Gracilaria textorii* and *turbenaria arnata* were collected from the coast of Visakhapatnam. The algal sample was handpicked and washed thoroughly with seawater to remove all the impurities, sand particles and epiphytes, transported to the laboratory and washed thoroughly using tap water to remove the salt on the surface of the sample. The algal material was spread on blotting paper to remove excess water. They were shade dried. The dried seaweed is finally pulverized in the commercial grinder and powdered seaweed samples are used for further analysis.

Extraction of Liquid Fertilizer from Seaweeds:

Plant materials of *G. textorii* and *T. arnata* were collected and washed with tap water to eliminate epiphytes found on the alga. The samples were shade dried for 8-10 days, then powdered and stored in polythene bags.

Extraction: There are two simple methods of extracting the algae

A. By boiling: 100g of shade dried and powdered seaweed suspended in one liter of deionized water was heated to 100°C in water bath for one hour. The extract was filtered through a muslin cloth and measured and stored in a refrigerator.

B. By heating: 100g of seaweed was cut into small pieces; one liter of deionized water was added and heated to 500°C for 24h. It was filtered, measured, bottled and stored in a refrigerator. About 100ml of seaweed liquid extract was used to prepare 2.5%, 5%, 10% and 20% concentrations by diluting with deionized water. The diluted extract in different concentrations was sprayed on the crop every 5 days interval.

Seed soaking:

The seaweed liquid fertilizer was prepared with different concentration that is 2.5%, 5%, 10%, 15% and 20%. Then the sowing seeds were soaked in particular concentration of SLF and control for 12 hrs. Then the seeds sowed and observed for germination and early growth. The weeds were removed regularly and watering was done daily for the test plants.

Application of Seaweed Liquid Fertilizer on Vegetable crop

Three crop plants raised in the nursery such as Brinjal and Chilly were selected in the present investigation to examine the effect of the seaweed liquid fertilizer on these crops. The seeds were soaked in different ratios of the SLF for 12 hours. Seeds soaked in water served as control in these experiments. Rate of germination was observed in control as well as in various concentrations of SLF. Seedlings were planted in different rows for application of different concentrations of fertilizer through foliar method. At the end, crop productivity was estimated.

Analysis:

Plants from each treatment were randomly drawn for various analyses. The grown parameter including germination percentage, fresh and dry weight, roots length and shoot length was calculated. Foliar application was done in once in five days for the test plants.

Statically analysis:

Data was analyzed statistically using ANOVAs for CRD. All the measurements were triplicates.

RESULTS

The physico-chemical properties of the extract of seaweed have been analyzed. The extract contained macro nutrients like nitrogen, phosphorus, potassium, magnesium, calcium and micro nutrients like iron, manganese, zinc, copper and growth hormones like cytokinin, auxin.

The seaweed extract was found effective in increasing the growth and yield in the low level of SLF (5% conc.). Maximum seed germination of brinjal was observed in low conc. (2.5% conc.) of SLF and minimum germination rate was reported high conc. (20% conc.) and control. Similar results were obtained at low conc. of SLF from *Stoecheospermum marginatum* on brinjal. Seaweed liquid fertilizers were found superior than chemical fertilizer because of the presence of high levels of organic matter¹ Aitkin and Senn (1965). The growth parameters and yield parameters were recorded in the plants treated with SLF. This observation is in conformity with the earlier report on the promotional effect of *Zizypus mauritiana* with crude extract of seaweed. Increased yield in banana, potato, oranges, ground nut. Similar trend was also observed in bhendi, tomato, okra and cow pea.

The present study revealed that the foliar treatments using extract *Gracillaria textorii* and *turbenaria arnata* exhibits promising effects on growth and yield characteristics of the test plant brinjal and tomato. The growth promoting properties of the seed treatment using seaweed extract improves the quality of the soil and increase the crop yield. This study also confirms that use of SLF is a wise eco friendly technique to enhance crop production. The results obtained from the growth and yield parameters of brinjal treated with different concentrations of SLF *Sargassum wightii* and control are presented table 1(1.1, 1.2), 2(2.1, 2.2), 3(3.1, 3.2) and 4(4.1, 4.2).

Table: 1.1 Effect of seaweed extract, *Gracillaria textorii* on the growth of brinjal

Parameters	Control	2.5 % concentration	5% concentration	10% concentration	20% concentration
Root length	8.86±0.50	14.26±0.60	12.56±0.50	12.26±0.30	10.36±0.45
Shoot length	13.3±0.65	20.7±0.65	17.5±0.30	16.2±0.85	14.3±0.60
No. of leaves	8±0.4	14±0.2	12±0.47	10±0.2	9.8±0.41
No. of flowers	10.0±0.4	16.0±0.2	14.02±0.2	12.26±0.4	11.26±0.2
Fresh weight	4.60±0.50	12.06±0.45	10.18±0.50	9.30±0.2	7.10±0.5
Dry weight	1.06±0.1	4.96±0.25	3.96±0.20	3.01±0.25	2.56±0.1

Table: 1.2 Effect of seaweed extract of *Gracilaria textorii* on the yield of brinjal

Parametes	control	2.5 % concentration	5% concentration	10% concentration	20% concentration
No. of fruits	4.66±0.47	11.66±0.41	9.0±0.41	7.26±0.56	6.56±0.47
Fruit fresh weight	3.50±0.2	8.66±0.36	6.26±0.41	5.86±0.47	4.66±0.47

Table: 2.1 Effect of seaweed extract of *Gracilaria textorii* on the growth of tomato

Parameters	Control	2.5 % concentration	5% concentration	10% concentration	20% concentration
Root length	6.01±0.2	12.26±0.30	10.36±0.45	8.86±0.50	7.20±0.2
Shoot length	16±0.1	29.3±0.20	25.3±0.35	23.0±0.3	20.80±0.3
No. of leaves	6.01±0.1	14.53±0.5	12.36±0.45	10.20±0.2	8.33±0.4
No. of flowers	10.66±0.4	17.26±0.2	13.14±0.4	12.26±0.2	10.66±0.41
Fresh weight	3.60±0.50	10.06±0.45	8.18±0.50	7.30±0.2	5.10±0.5
Dry weight	1.06±0.1	5.96±0.25	3.96±0.20	3.01±0.25	2.56±0.1

Table: 2.2 Effect of seaweed extract of *Gracilaria textorii* on the yield of tomato

Parametes	control	2.5 % concentration	5% concentration	10% concentration	20% concentration
No. of fruits	6.66±0.47	12.66±0.41	10.66±0.4	8.26±0.3	7.56±0.47
Fruit fresh weight	1.66±0.47	5.76±0.41	4.66±0.36	3.26±0.41	2.86±0.47

Table: 3.1 ffect of seaweed extract, *Turbenaria arnata* on the growth of brinjal

Parameters	Control	2.5 % concentration	5% concentration	10% concentration	20% concentration
Root length	8.86±0.50	14.26±0.60	12.56±0.50	12.26±0.30	10.36±0.45
Shoot length	13.3±0.65	20.7±0.65	17.5±0.30	16.2±0.85	14.3±0.60
No. of leaves	8±0.4	14±0.2	12±0.47	10±0.2	9.8±0.41
No. of flowers	10.0±0.4	16.0±0.2	14.02±0.2	14.26±0.4	12.26±0.2
Fresh weight	4.60±0.50	12.06±0.45	10.18±0.50	9.30±0.2	7.10±0.5
Dry weight	1.06±0.1	5.90±0.25	4.60±0.20	3.01±0.25	2.56±0.1

Table: 3.2 Effect of seaweed extract of *Turbenaria arnata* on the yield of brinjal

Parametes	control	2.5 % concentration	5% concentration	10% concentration	20% concentration
No. of fruits	4.66±0.47	10.66±0.3	8.0±0.41	7.26±0.2	6.56±0.3
Fruit fresh weight	3.50±0.2	8.66±0.36	6.26±0.3	5.86±0.4	4.66±0.40

Table: 4.1 Effect of seaweed extract, Turbenaria arnata on the growth of Tomato

Parameters	Control	2.5 % concentration	5% concentration	10% concentration	20% concentration
Root length	6.01±0.2	16.26±0.30	12.36±0.45	10.86±0.50	8.20±0.2
Shoot length	16±0.1	30.3±0.20	28.3±0.5	23.0±0.3	20.80±0.3
No. of leaves	6.01±0.1	18.53±0.5	14.36±0.45	12.20±0.2	10.33±0.4
No. of flowers	10.66±0.4	18.26±0.2	12.14±0.47	11.26±0.2	10.66±0.41
Fresh weight	3.60±0.50	10.06±0.45	8.18±0.50	6.30±0.2	5.10±0.5
Dry weight	1.06±0.1	5.96±0.25	3.96±0.20	3.01±0.25	2.56±0.1

Table: 4.2 Effect of seaweed extract of Turbenaria arnata on the yield of tomato

Parametes	control	2.5 % concentration	5% concentration	10% concentration	20% concentration
No. of fruits	6.66±0.47	14.66±0.41	12.66±0.41	10.26±0.56	8.56±0.47
Fruit fresh weight	1.66±0.47	6.76±0.41	4.66±0.36	3.26±0.41	2.86±0.47

CONCLUSION

The seaweed extract prepared from *G. textorii* and *T. ornata* was found to be promising in possessing fertilizer activity. Hence, this simple practice of application of eco friendly seaweed liquid fertilizers to vegetables is recommended to the farmers for attaining better growth and yield over chemical fertilizers. Seaweed extracts can be recommended as bio fertilizer to be used alone or in combinations with other bio fertilizers and applied to either soil or foliage for improved growth. With abundant distribution, great regeneration potential and easy mass cultivation, the seaweed bio fertilizer seems a feasible substitute to synthetic fertilizers. If such seaweeds extracts are used for organic farming, our dependence on chemical fertilizers can be reduced.

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