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Influence of seaweed liquid fertilizer of *ulva lactuca* on the seed germination, growth, productivity of *Abelmoschus esculentus (L.)*

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Abstract
The present investigation is an attempt to study the influence of seaweed liquid fertiliger (SLF) extracted from the marine green algae *ulva lactuca* on the growth parameters of *Abelmoschus esculentus* (l) medikus. The seeds were soaked in different concentrations of SLF viz., 2.5%, 5%, 10%, 20% and control for 6h. The foliar spry was applied twice at four concentrations of seaweed extract. The maximum growth was recorded at 5% concentration viz., seed germination, shoot length, root length, number of flowers, number of fruits, fresh weight and dry weight when compare to control and remaining concentrations of seaweed extract. The seaweed extract are found effective in increasing the growth parameters.
Keywords: Liquid Seaweed Fertilizer, foliar application, SLF, productivity

1. Introduction
Seaweeds are marine macro algae which form an important component of marine living resources of the world. Seaweed and it derived products are used as food, fodder in the coastal areas throughout the globe. The high amount of water soluble potash, other minerals, trace elements and plant growth hormones present in seaweeds. Although seaweed extracts are widely advertised for use as fertilizers, agricultural scientists have only rarely investigated their effects. Many different beneficial effects have been described following the application of seaweed extracts to crops [1]. Seaweed extracts have been shown to increase the crop yield, improve growth, induce resistance to frost, fungal and insect attacks. In modern Agriculture, extensive application of chemical fertilizers caused imbalance of soil nutrients. So, search for natural organic inputs for sustainable crop productivity has been emphasized. Bio-fertilizers are a 100 % natural organic fertilizer that helps to provide all the nutrients to the soil required for the plants. Bio-fertilizers based on renewable energy sources are most effective supplement to chemical fertilizers. Seaweeds are rich source of growth promoting substances [2] such as IAA, kinetin, zeatin and gibberellins [3] auxins and cytokinins [4]; metabolic enhancers [5] ; macro and micro elements [6], amino acids, vitamins and beneficial results from their use in crop plants like early seed germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stress and enhanced post harvest shelf life of seeds [7][8][9]. India is an agricultural country; nearly 70% of the nitrogen and phosphorus then the farm manure. There population thrives in rural areas, engaged in agriculture are many plant growth hormones, regulators and making the backbone of our economy. The fast growing promoters available to enhance yield attributes 1Population is mounting tremendous pressure in food Seaweed liquid fertilizers will be useful for achieving production in the country. To meet out this increasing higher agricultural production, because the extract demand, farmers use chemical fertilizers to enhance the contains growth promoting hormones (IAA and IBA), crop production.

2. Materials and Methods
2.1. Study area
The study area of the sample collection was Visakhapatnam. Visakhapatnam lies on the east coast of India between latitudes17^0 14^l 30^{ll} and 17^0 45^1 and longitudes 83^0 16^l 25^{ll} and 83^0 21^1 30^{11} with vast resources of marine algal species.

2.2. Collection of sample
The seaweed sample *ulva lactuca* was collect 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.

2.3. Preparation of seaweed liquid fertilizer

The seaweed liquid fertilizer is prepared by the method Ramarao (1990)[12]. The seaweed powder was added with distilled water in a ratio 1:20(w/v) and autoclaved at 1200 15 1bs/sq for min. hot extract was filtrate through double layered cheese cloth. The filtrate was taken and stored refrigerator. The extract was used to prepare different concentration of SLF by adding distilled water.

2.4. Seed soaking

The seaweed liquid fertilizer was prepared with different concentration that is 2.5%, 5%, 10%, 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.

2.5. 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.

2.6. Statically analysis

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

3. Results and Discussions

The physic chemical properties of the extract of seaweed *ulva lactuca* 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 and their values are given table.1. A stimulating effect of seaweed liquid fertilizer on seed germination and growth was observed. The seeds soaked in (2.5%, 5%) concentrations of SLF showed higher rates of germination while the higher concentration (10%, 20%) inhibited the seed germination. This is in agreement with the earlier observation that seaweed extract induced varying seed germination [10]. SLF influenced on growth parameters such as Root length, shoot length, no. of leaves, no. of flowers and no. of fruits. SLF also influenced on fresh weight, dry weight of plants and fruits. Compared to control, plant spry with SLF (2.5%) significant increase (Table 2, 3) number of leaves (8.33±0.4), number of flowers (11.26±0.2), number of fruits (7.66±0.41), fresh weight (13.06±0.45), and dry weight (5.96±0.25) of plant. Promotive effects of SLF application might be because of increased root proliferation and establishment, thereby plants was able to mine more nutrients even from distant places and deeper soil horizons, in balanced propotion [11].

Table.1: Mineral compositions of seaweed extract ulva lactuca

Macro nutrients (mg/g dry weight)		**Micro nutrients (mg/g dry weight)**		**Plant growth hormones (µg/g dry weight)**	
Nitrogen	174.02	Iron	8.74	cytokinin	370.86
Phosphorus	45.56	Manganese	5.69	Auxin	290.52
Potassium	75.83	Zinc	1.81		
Magnesium	67.71	Copper	1.71		
Calcium	97.75				

The results obtained from the growth and yield parameters of *Abelmoschus esculentus* (L.) treated with different concentrations of SLF *ulva lactuca* and control are presented table 2 and 3.

Table 2: Effect of seaweed extract, *ulva lactuca* on the growth of *Abelmoschus esculentus* (L.)

Parameters	**Control**	**2.5 % concentration**	**5% concentration**	**10% concentration**	**20% concentration**
Root length	8.86±0.50	15.26±0.60	13.56±0.50	12.26±0.30	10.36±0.45
Shoot length	25.3±0.65	38.7±0.65	35.5±0.30	30.2±0.85	29.3±0.60
No. of leaves	3±0.81	8.33±0.4	6.01±0.1	5.53±0.5	3±0.95
No. of flowers	4.66±0.4	11.26±0.2	9.14±0.47	7.26±0.2	6.66±0.41
Fresh weight	4.60±0.50	13.06±0.45	10.18±0.50	9.30±0.2	7.10±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 3: Effect of seaweed extract, *ulva lactuca* on the yield of *Abelmoschus esculentus* (L.)

Parameters	Control	2.5 % concentration	5% concentration	10% concentration	20% concentration
No. of fruits	1.66±0.47	7.66±0.41	5.66±0.41	3.26±0.56	2.56±0.47
Fruit fresh weight	1.66±0.47	12.76±0.41	7.66±0.36	5.26±0.41	3.86±0.47

4. Conclusion

It is clear from the current study that seaweeds extract of *ulva lactuca* have an ameliorating effect on *Abelmoschus esculentus* seeds under salt stress because of the presence of growth hormones, nutrients and other important physiochemical compounds. So, the supplementation of SLF could be used as a biological amendment in soil reclamation technique which can boost food production not only in cultivated lands but also in barren soils accumulated with salt. Further study will be needed to test the influence of SLF on later growth and yield of *Abelmoschus esculentus* cultivated in salt stress.

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