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Seaweed extract as a biostimulant for legume crop, green gram

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Abstract

The aim of this research is to investigate the effect of seaweed extracts obtained from the marine green algae, *Ulva lactuca* Linnaeus, *Caulerpa scalpelliformis* (R.Brown ex Turner) C. Agardh, brown algae *Sargassum plagiophyllum* C. Agardh, *Turbinaria conoides* (J. Agardh) Kutzing, *Padina tetrastromatica* Hauck, *Dictyota dichotama* (Hudson) J. V. Lamouroux on the stimulate germination, growth parameters of the *Vigna radiata.* The present study reveals the seeds germination, fresh weight and dry weight of shoots and roots. These results suggested that seaweed extracts stronger induce seed germination and growth parameters.

Keywords: Seaweed Extracts, Biostimulant, Green Gram, Seed Germination

INTRODUCTION

Seaweeds are one of the most important marine resources of the world. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results from their use have been reported (Booth, 1965). The possibilities of using seaweed in modern agriculture have been investigated by many (Thivy, 1961; Aitken and Sen, 1965; Boney, 1965). Different forms of sea weed preparation such as LSF (Liquid Seaweed Fertilizer), SLF (Seaweed Liquid Fertilizer) LF (Liquid Fertilizer), and either whole or finally chopped powered algal manure have been used and all of them have been reported to produce beneficial effects on cereals, pulses, and flowering plant. Seaweed manure has the advantage of being free from weeds and pathogenic fungi. Liquid extracts of brown algae are being sold as biostimulants or biofertilizers in various brand names. Promising increased crop yield, nutrient uptake, resistance to frost and stress, improved seed germination of reduced incidents of fungal and insect attack have been resulted by application of seaweed extracts. Seaweeds are known to contain appreciable quantities of plant growth regulators (Mooney and Van Staden, 1985), cytokinin (Smith and Van staden, 1984), IAA (Abe *et al*., 1972), gibberellins and gibberellins-like substances (Bentley, 1960; Sekar *et al.,* 1995*).*

Seaweed extract as organic biostimulant is fast becoming accepted practice in horticulture due to its beneficial effects (Verkleij, 1992). SLF treatment increased the number of branches and concentration of photosynthetic pigments (S. Sridhar and R. Rengasamy, 2010). Crop cultivation using organic fertilizers has contributed for deposition of residues, improving physical and chemical properties of soil that is important for biological development (Galbiattia *et al.,* 2007). Seaweed extracts reported to improve seed germination in several species such as Table beet (Wilczek and Ng, 1982), Lettuce (Moller and Smith, 1998) and Faba bean (El-Sheekh and El-Saled, 2000). In experimental studies it was shown that growth of seedlings was stimulated by the seaweed extracts of green algae (*Ulva lactuca*, *Caulerpa scalpelliformis*) and brown algae *(Sargassum plagiophyllum, Turbinaria conoides, Padina tetrastromatica, Dictyota dichotama).* In the present study, We aimed to the applicability of six different seaweed extracts was tested regarding stimulation of seed germination and growth parameters of the *Vigna radiata* (Green gram).

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MATERIALS AND METHODS

Collection of Seaweeds

The seaweeds *Ulva lactuca*, *Caulerpa scalpelliformis, Sargassum plagiophyllum, Turbinaria conoides, Padina tetrastromatica, Dictyota dichotama* were collected from Mandapam coast, Tamil Nadu during November 2010. The seaweeds were handpicked and washed thoroughly with seawater to remove the unwanted impurities, adhering sand particles and epiphytes. They were transported to the laboratory in polythene bags. Samples were washed thoroughly using tap water to remove salt the surface salt and then blotted to remove excess water.

Preparation of Seaweed Extract

Seaweeds were shade dried for four days, followed by oven dry for 12h at 60°C. Then the materials were hand crushed and made as coarse powder was added with distilled in a ratio of 1: 20 (w/v) and autoclaved at 121°C, 15lbs/sq.inch for 30 minutes. The hot extracts were filtered through a double-layered cheese cloth and allowed to cool at room temperature (Rama Rao, 1990). The filtrate was centrifuged at 10,000rpm for 15 minutes. The resulting supernatant was taken as 100 % seaweed liquid extracts. Seaweed liquid extracts were prepared with different doses viz., 0.1%, 0.2%, 0.3%, 0.4%, and 0.5%.

Seed Treatment

The green gram seeds were surface sterilized with 0.1% $HgCl_2$, washed thoroughly 3-5 times in sterilized distilled water and then the sowing seeds were soaked in particular doses of seaweed extracts for 12 hrs. The seeds were placed on top of the filter paper wetted with 5 ml of each different concentrations of seaweed extracts in the petri dishes were kept under day fluorescent light with 3000-lux

intensities for 5 days. The culture room temperature was maintained at 27°C. In control, seeds with distilled water on the paper in the petri dishes under the same conditions. After five days old seedlings taken for the observations, Growth parameters including % of seed germination, root length, shoot length, total height, number of lateral roots, fresh weight, and dry weight was measured. The plant weight was also estimated using electronic balance. Seedlings kept at 60±5°C for 48 hours and weighted for determination of their dry weights.

Statistical Analysis

Data were analyzed statistically for standard deviation, using MS Excel. All measurements were performed with triplicates. The results were tabulated.

RESULTS AND DISCUSSION

The analyses of seaweed extracts obtained from, *Ulva lactuca*, *Caulerpa scalpelliformis,* the brown algae, *Sargassum plagiophyllum, Turbinaria conoides, Padina tetrastromatica, and Dictyota dichotama* on the *Vigna radiata* seeds were analyzed and are presented in table 1, 2, 3, 4, 5 and 6. Aitkin and Senn recorded lower concentration seaweed extract showed increased seed germination on ornamental plants, Tobacco, Pea and cotton. Dhargalkar and Untawale reported that SLF treatment enhanced the rate of seed germination in green Chilies and Turnip and found that lower concentration of SLF increase the germination percentage than the higher concentration.

Table: 1 Seaweed extract of *Sargassum plagiophyllum* (Phaeophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	60	70	80	90	80
Root length(cm)	4±1.224	5.6±1.816	4.8±1.303	5.6±0.547	8.2±1.303	6.2±2.167
Shoot length(cm)	6.2±1.923	9±1.581	9.6±2.701	9.8±0.894	12.8±1.483	10.6±1.341
Total height(cm)	10.6±2.073	14.4±1.673	16.6±1.673	17.2±2.280	19.8±1.923	16±2.449
No. of lateral roots	9.2±3.563	17±4.242	19±7.745	15±5.099	15.6±4.393	12.6±3.646
Fresh weight (gm)	0.210±0.030	0.303±0.013	0.356±0.531	0.351±0.066	0.363±0.028	0.322±0.042
Dry weight (gm)	0.034±0.011	0.034±0.003	0.031±0.003	0.034±0.007	0.035±0.005	0.034±0.008

Table: 2 Seaweed extract of *Turbinaria conoides* (Phaeophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	80	80	90	80	80
Root length(cm)	4±1.224	6±1.224	6±1.224	8.8±0.836	6.2±1.303	5.8±0.836
Shoot length(cm)	6.2±1.923	11±0.707	10.2±1.483	16.4±1.816	9±1.414	11.6±2.073
Total height(cm)	10.6±2.073	16.2±1.303	15.8±0.836	21±1.870	14.8±1.483	16.2±0.836
No. of lateral roots	9.2±3.563	14.4±3.507	12.8±4.324	9.8±2.774	13±2.915	17.2±2.774
Fresh weight (gm)	0.210±0.030	0.349±0.046	0.375±0.046	0.407±0.022	0.293±0.040	0.339±0.026
Dry weight (gm)	0.034±0.011	0.036±0.004	0.035±0.006	0.042±0.003	0.028±0.010	0.036±0.007

Table: 3 Seaweed extract of *Padina tetrastromatica* (Phaeophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	100	80	90	60	60
Root length(cm)	4±1.224	6.2±1.923	4.2±0.447	5.2±1.303	4.2±0.836	5±1.581
Shoot length(cm)	6.2±1.923	9.6±2.017	8.2±2.280	8.8±2.049	11±2.385	7.8±1.581
Total height(cm)	10.6±2.073	20±5.385	14.2±4.658	13.8±5.263	14.6±5.224	12.2±2.049
No. of lateral roots	9.2±3.563	20.6±5.128	14.2±4.658	13±5.263	14.6±5.224	12.2±2.049
Fresh weight(gm)	0.210±0.030	0.401±0.052	0.318±0.051	0.318±0.051	0.326±0.039	0.293±0.054
Dry weight(gm)	0.034±0.011	0.063±0.011	0.032±0.009	0.043±0.012	0.034±0.009	0.033±0.007

Table: 4 Seaweed extract of *Dictyota dichotama* (Phaeophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	70	80	50	90	70
Root length(cm)	4±1.224	5.4±1.673	4.4±1.140	5.2±1.303	7.6±1.341	5.6±1.140
Shoot length(cm)	6.2±1.923	9.8±1.095	10.6±3.361	9.4±2.073	12.2±3.114	9.2±1.303
Total height(cm)	10.6±2.073	13.6±3.435	10.6±4.615	13.8±2.949	18.2±5.263	13.4±3.209
No. of lateral roots	9.2±3.563	16.2±5.630	10.8±3.898	11.6±4.878	18.6±3.209	12.6±3.130
Fresh weight (gm)	0.210±0.030	0.331±0.017	0.329±0.060	0.297±0.089	0.392±0.032	0.300±0.057
Dry weight (gm)	0.034±0.011	0.035±0.006	0.037±0.009	0.042±0.007	0.046±0.004	0.037±0.008

Table: 5 Seaweed extract of *Ulva lactuca* (Chlorophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	70	90	80	80	60
Root length(cm)	4±1.224	5.4±2.302	7.4±1.140	6.8±1.923	4.4±0.894	4.8±1.095
Shoot length(cm)	6.2±1.923	10.2±1.923	11.2±2.387	7.8±1.923	7.6±1.140	7.4±1.516
Total height(cm)	10.6±2.073	15.4±2.302	18.8±1.483	14.6±1.816	11.6±1.516	11.8±0.836
No. of lateral roots	9.2±3.563	17.2±4.868	17.2±6.058	12.4±5.770	11.8±2.683	8.8±3.346
Fresh weight (gm)	0.210±0.030	0.292±0.022	0.385±0.034	0.285±0.038	0.285±0.027	0.296±0.062
Dry weight (gm)	0.034±0.011	0.039±0.005	0.042±0.002	0.031±0.005	0.035±0.007	0.032±0.001

Table: 6 Seaweed extract of *Caulerpa scalpelliformis* (Chlorophyceae) on germination and Growth of *Vigna radiata* seedlings

Seaweed extract concentration	control	0.1%	0.2%	0.3%	0.4%	0.5%
% of Germination	70	70	80	70	100	90
Root length(cm)	4±1.224	4.2±1.095	4.8±1.303	4.4±0.547	8.2±0.083	5.2±0.836
Shoot length(cm)	6.2±1.923	11.2±1.095	9.8±2.489	9.2±1.923	11.4±1.816	9.2±1.483
Total height(cm)	10.6±2.073	15.2±3.346	14.4±3.049	13.2±1.788	17.4±1.516	14.2±2.387
No. of lateral roots	9.2±3.563	14.4±3.310	17.6±5.029	10.6±1.516	18.2±5.630	12.4±2.880
Fresh weight (gm)	0.210±0.030	0.313±0.070	0.302±0.043	0.293±0.025	0.389±0.035	0.316±0.049
Dry weight (gm)	0.034±0.011	0.028±0.010	0.033±0.004	0.029±0.005	0.041±0.003	0.041±0.012

The lowest germination percentage (50%) was found at 0.3% extract of brown seaweed, *Dictyota dichotama* (Table: 4). The highest germination (100%) of the green gram was recorded with 0.4% *Caulerpa scalpelliformis* (Table: 6) and 0.1% *Padina tetrastromatica* extract tested (Table: 3). Maximum root length (8.8±0.836cm) of the *Vigna radiata* observed at 0.3% concentration of *Turbinaria conoides* treatment (Table: 2). The lowest root length (4.2±0.447cm) was observed at seaweed extract level (0.2%) of brown seaweed *Padina tetrastromatica*. The maximum shoot length of the green gram was observed at 0.3% concentration of *Turbinaria conoides* treatment among the six seaweeds tested (16.4±1.816). The lowest shoot length (7.4±1.516cm) was observed at the highest obtained record with (20±5.385cm) observed at 0.5% *Ulva lactuca*. The maximum lateral roots (10.6±1.516) observed at 0.3% *Caulerpa scalpelliformis*. Sekar *et al.,* (1995) reported the fresh weight of green gram seedlings tested with all the six seaweed extracts treatment was gradually decreased with increasing concentration of seaweed extract from *Ulva lactuca* promoted the growth of *Vigna unguiculata.* Kamaladhasan and Subramanian, 2009 also reported similar effect in Red gram and Lingakumar *et al.,* (2002) and Thevanathan *et al.,* (2005) reported linear growth of both shoots and roots in *Vigna unguiculata* and *Phaseolus munga*. Similar typical growth promotion was observed in this study at lower concentration of the *Sargassum plagiophyllum* extract. The increased seedling growth may be due to presence of some growth promoting substances such as IAA and IBA, Gibberellins, Cytokinins, micronutrients and amino acids (Challen and Hemingway, 1966).

CONCLUSION

In conclusion, considering the above important findings the seaweed extract derived from *Ulva lactuca*, *Caulerpa scalpelliformis,* the brown algae*, Sargassum plagiophyllum, Turbinaria conoides, Padina tetrastromatica, Dictyota dichotama* are effective in increasing the growth promoting hormones and nutrients in more quantities in the seaweed extract can be applied to pulse crop, green gram of South India recommended to the growers for attaining better germination, growth and yield of cultivable plants.

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