

Influence of Seaweed Liquid Extracts on Growth, Biochemical and Yield Characteristics of *Cyamopsis tetragonolaba* (L.) Taub.

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Article Info	Summary
Article History Received : 19-05-2011 Revised : 03-08-2011 Accepted : 07-08-2011	Seaweed liquid extracts of marine alga <i>Stoechospermum marginatum</i> significantly enhanced the growth, biochemical and yield of the cluster plant when treated as soil drench. Seaweed Liquid extracts (SLE) at lower concentration (1.5%) was found to have maximum influence on growth parameters viz., shoot length, root length, fresh weight, dry weight, leaf area and moisture content. Moreover, biochemical parameters such as photosynthetic pigments, protein content, sugars, ascorbic acid and nitrate reductase activity were also enhanced when compared to untreated seedlings. There was also noticeable increase in number of clusters/plant, number of flowers/clusters, pod weight, pod length and number of seeds per pod. Higher concentrations (above 1.5%) were found to show inhibitive effect.
*Corresponding Author Tel : +91-9894289088 Email: vijayapsac@gmail.com vijayapsa@rediffmail.com	Key Words: Seaweed extract; <i>Stoechospermum marginatum</i> ; growth, biochemical, yield, cluster bean
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Introduction

Nowadays, application of biostimulants has become an alternative approach to minimize the use of chemical fertilizers. Seaweeds are the macroscopic marine algae found attached to the bottom in relatively shallow coastal waters. They grow in the intertidal, shallow and deep sea areas up to 180 meter depth and also in estuaries and backwaters on the solid substrate such as rocks, dead corals and pebbles [4]. Seaweed liquid extract (SLE) which contains macro nutrients, trace elements, organic substances like amino acids and plant growth regulators such as auxin, cytokinin and gibberellins are applied to improve nutritional status, vegetative growth, yield and fruit quality in some plants [1,2,3].

At present, the use of natural seaweed products as substitutes to conventional inorganic fertilizers has gained importance [5, 6]. Moreover, application of algal extracts in modern agriculture has been reported in some plants [7, 3, 8, 9, 4, 10, 2, 1]. Some commercial products available in market such as, Maxicrop, Algifert, Goemar, Kelpak, Seaspray, Seasol, SM3, Cytex and Seacrop. Seaweed fertilizers are better than other fertilizers and are very economical. Our present study was undertaken to study the fertilizing efficiency of seaweed liquid extracts of *Stoechospermum marginatum* on cluster bean.

Materials and Methods

Preparation of algal extracts

The marine alga *Stoechospermum marginatum* (Ag. Kuertz.) which belongs to Phaeophyceae was collected from Mandapam (Lat 9° 45' N; Long 79° 15' E) located in South East Coast of Tamilnadu. The alga was brought to the laboratory and washed thoroughly in tap water for 3 or 4 times to remove all epiphytes, sand particles and associated fauna. The wet weight of sample of collected algal samples was

taken, shade dried and then the sample dry weight was determined. Different concentrations of boiled extract was prepared by mixing appropriate level of liquid extracts with distilled water [11]. Treatments used in this experiment ranged from 0.5% to 5.0%.

Preparation of Pot study

Seeds of cluster bean were purchased from Agriculture College and Research Institute, Madurai. They were surface sterilized with 0.1% mercuric chloride and then sown in earthen ware pots (9 cm dia) filled with sterilized standard soil mix supplemented with sufficient quantity of NPK. The seed to seed distance in pot was maintained as 3-5 cm and pots were maintained regularly. Potted plants were drenched with different concentrations of liquid extracts. Plants were soil drenched with extracts after 20 days. About 50 ml of different concentrations of extracts were given at interval of 3 days. Growth parameters viz., shoot length, root length, total height, total fresh and dry weight, leaf area, moisture content and were determined. Photosynthetic pigments [12], protein content [13], reducing sugar [14], ascorbic acid [15] and nitrate reductase activity [16] were assessed in the leaves of treated plants. Growth parameters and biochemical parameters were observed in 4 weeks old treated and control plants. After 60 days, yield parameters were observed. All pot experiments were done in four replicates each under natural uniform conditions

Physico-chemical and hormone analysis of seaweed extracts of *Stoechospermum marginatum*

The physical observations such as colour and pH and elements such as copper, manganese, iron, zinc, cobalt, potassium, magnesium and sodium were estimated using

Atomic Absorption Spectrophotometer [17]. Further, liquid extracts of both seaweeds were subjected for estimation of

auxin [18], gibberellin [19] and cytokinin [20].

Table 1: Physio-chemical and hormone analysis of liquid extract of *Stoechospermum marginatum*

<i>Stoechospermum marginatum</i>	
Colour	Brown
pH	6.3
Chemical parameters	
Copper	3.1
Manganese	0.53
Zinc	1.283
Iron	0.53
Potassium	2.070
Magnesium	18.13
Cobalt	0.103
Sodium	5.75
Phytohormones	
Auxin	2.5
Cytokinin	7.5
Gibberellin	4.8

All the parameters given are in mg/L except colour and pH.

Results and Discussions

In our experiments, use of seaweed liquid extracts of *Stoechospermum marginatum* significantly increased the rate of growth and physiology of cluster bean. There was a noticeable increase in growth, biochemical and yield characters when 1.5% of seaweed liquid extracts of *Stoechospermum marginatum* was applied to the test plant. Higher concentrations (2.0% and above) were found to show inhibiting effect on all above parameters studied. Total plant height (33%), total fresh (155%) and dry weight (140%), leaf area (61%) and moisture content (55%) were found to be increase when 1.5% concentrations of extract was applied. Further, there was a retarding effect in growth parameters when the plants were treated with 2.0%, 2.5% and 5.0% (Table

2). Statistically significant differences were observed in total plant length, fresh and dry weight, leaf area and moisture content. Similar observations have been made in earlier studies in *C. cajan* [21], *Vigna radiate* [22], maize, ragi and kambu [23], *Dolichos biflorus* [24], Cumbu [25], Cluster bean [26]. On other hand, 1% *Padina boergesenii* extract significantly increased the shoot length, leaf breadth, leaf length, root length and number of roots in *Rhizophora mucronata* [40]. Our results also corroborated with the previous studies on SLE applications [30,31,9,10,7]. The growth enhancing potential of seaweed might be attributed to the presence of carbohydrate [28], Phenyl acetic acid [29], micro and macro elements [27]. Our results also corroborated with the previous studies on SLE applications [30,31,9,10, 7].

Table 2 : Influence of liquid extract of *Stoechospermum marginatum* on growth characteristics of cluster bean

Treatments	Shoot length (cm)	Root length (cm)	Total height (cm)	Total fresh wt (mg)	Total dry wt (mg)	Leaf Area (mm ²)	Moisture content (%)
Control	8.725 b	12.250 a	20.00 ab	1.015 a	0.400 a	42.115 b	41.533 a
0.5%	9.325 b	13.050 ab	21.400 bc	1.130 bc	0.492 b	44.183 b	54.685 bc
1.0%	10.000 c	13.400 bc	26.650 bc	1.620 de	0.620 c	50.790 c	63.645 bc
1.5%	11.400 cd	15.250 d	23.325 bc	2.595 f	0.962 d	68.165 d	64.825 c
2.0%	10.300 c	14.450 cd	24.750 c	1.800 e	0.605 c	58.400 d	64.808 c
2.5%	8.950 b	14.200 cd	23.150 bc	1.365 cd	0.515 b	3.425 b	53.720 b
5.0%	6.425 a	12.300 a	18.725 a	0.915 ab	0.400 a	35.450 a	55.785 bc

Means sharing within the rows are significantly different ($P \leq 0.05$ level).

Different letters followed in each row statistically significant based on DMRT

Cluster bean plants when treated with different concentrations of *Stoechospermum marginatum* extracts showed an remarkable increase in the biochemical parameters also. Photosynthetic pigments, proteins, sugars and nitrate

reductase activity were enhanced in cluster bean plants when 1.5% concentration of extracts was given. Other treatments such as 2.0%, 2.5% and 5.0% showed only inhibitive effect (Table 3).

Table 3: Influence of liquid extracts of *Stoechospermum marginatum* on biochemical characteristics of cluster bean

Treatments	Chl-a (mg.g ⁻¹ fr.wt)	Chl-b (mg.g ⁻¹ fr.wt)	Total Chlorophyll (mg.g ⁻¹ fr.wt)	Protein (mg.g ⁻¹ fr.wt)	Reducing sugar (mg.g ⁻¹ fr.wt)	Ascorbic acid (mg.g ⁻¹ fr.wt)	NRA (μ moles No- ² /gm.fr.wt/hr)
Con	0.5225 a	0.4200 a	0.9425 a	19.200 b	41.650 a	0.568 a	0.820 a
0.5%	0.6500 a	0.4450 b	1.095 a	24.550 b	55.850 b	0.656 ab	1.090 b
1.0%	0.6650 ab	0.515 c	1.180 c	28.250 c	62.650 c	0.700 c	1.635 d
1.5%	0.975 d	0.710 d	1.685 d	33.30 d	84.10 d	0.775 bc	2.125 e
2.0%	0.805 c	0.530 b	1.335 b	26.625 bc	66.80 c	0.637 ab	1.725 d
2.5%	0.650 c	0.442 b	1.092 a	21.350 a	51.50 b	0.593 a	1.345 c
5.0%	0.590 b	0.315 a	0.905 a	19.90 a	39.10 a	0.562 a	0.970 ab

Means sharing within the rows are significantly different ($P \leq 0.05$ level)
Different letters followed in each row statistically significant based on DMRT

The increase in photosynthetic pigments may be due to the presence of betaines [32], increase in number and size of the chloroplast and better grana development [33]. The growth enhancing potential of seaweeds might be attributed to the presence of macro and micronutrients [27]. The increase in the protein content at lower concentrations of SLF might be due to absorption of most of the necessary elements by the seedlings [34], [24]. Similarly, 1% *Ulva lactuca* extract along with 50% recommended rate of chemical fertilizers enhanced the protein content, carbohydrate content and lipid content in *Tagetes erecta*. [41]. Moreover, seaweed liquid fertilizer extracted from brown alga *Sargassum wightii* at 10% concentration increased

the content of chlorophyll-a, chlorophyll-b, total chlorophyll, protein and total sugars in *Vigna radiata* [35]. On the contrary, lower concentration (20%) of seaweed liquid fertilizer enhanced the photosynthetic pigments and carotenoids in *Cyamopsis tetragonoloba* [4].

The cluster bean plants treated with liquid extracts of *Stoechospermum marginatum* showed differential responses in the yield characters also. *Stoechospermum marginatum* extract at 1.5% concentration significantly increased the number of cluster/plants, number of flowers/cluster, number of pods/plant, pod length and pod weight (Table 4).

Table 4: Influence of liquid extracts of *Stoechospermum marginatum* on yield parameters of cluster bean.

Seaweed treatments	Number of clusters/plant	Number of flowers/clusters	Number of Pods/plant	Pod length (cm)	Pod weight (g)
Control	4.000 bc	4.000 bc	2.250 a	6.250 bc	3.075 ab
0.5%	4.750 cd	5.000 cd	2.500 ab	6.750 cd	3.350 ab
1.0%	5.500 de	6.500 de	3.250 bc	8.250 e	3.750 bc
1.5%	6.250 e	7.750 e	3.500 c	8.750 de	4.725 c
2.0%	5.000 cd	4.750 cd	2.500 ab	6.750 cd	4.125 bc
2.5%	3.500 b	3.500 ab	2.500 ab	5.500 b	3.500 ab
5.0%	2.500 a	3.000 a	1.750 a	3.750 a	2.600 a

Means sharing within the rows are significantly different ($P \leq 0.05$ level).
Different letters followed in each row statistically significant based on DMRT

However, many other seaweed liquid extracts increased the yield in bean [36], Canola [37], cucumber [38]. In *Abelmoschus esculentus*, 2.5% of *Kappaphycus alvarezii* showed better increment in length, diameter and number of fruits [8]. Further, 1% foliar spray of seaweed liquid extracts increased the yield parameters such as fruit length and fruit weight in certain vegetable crops [39]. On the contrary, 20% seaweed extracts of *Rosenvigea intricata* increased the length and weight of *Cyamopsis tetragonoloba* [4].

Conclusions

Our present investigations revealed that enhancement on the growth, biochemical and yield characteristics of vegetable crop *Cyamopsis tetragonoloba* might be due to the presence of micro and macro elements, growth hormones, trace elements, vitamins etc. in our algal extracts. Cytokinin and magnesium which are considered as an essential growth promoting

hormone and chief constituent in chlorophyll biosynthesis respectively, could have played a vital role in enhancement in growth and physiology of cluster bean. On the other hand, increase in crop growth may vary according to chemical constituents of seaweed extracts. Further, the study also emphasizes that seaweed extracts can be effectively used as organic biostimulants to the plants and also an eco-friendly approach to organic farming.

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