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EFFECT OF SEAWEED LIQUID FERTILIZER OF *SARGASSUM WIGHTII* ON THE GROWTH AND BIOCHEMICAL CHARACTERISTICS OF *ABELMOSCHUS ESCULENTUS* (L.) MEDIKUS

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Abstract

The effect of different concentrations (20%, 40% 60%, 80% and 100%) of seaweed liquid fertilizer (SLF) of *Sargassum wightii* on the growth and biochemical characteristics of *Abelmoschus esculentus* was studied. The low concentration (20%) of *S. wightii* extract promoted the shoot length, root length, fresh weight, dry weight, chlorophyll, carotenoid, protein, amino acid, reducing sugar, total sugar, α-amylase and β-amylase activities in *Abelmoschus esculentus*.

Key Words: Seaweed liquid fertilizer; *Abelmoschus esculentus; Sargassum wightii*; Growth parameters; Biochemical constituents.

Introduction

Seaweeds or macroalgae 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 (Sekar et al.,1995;Rajkumar Immanuel and Subramanian, 1999; Gandhiyappan and Perumal, 2001; Selvaraj et al., 2004; Lingakumar et al., 2006). Seaweeds have recently gained importance as foliar sprays for several crops (Thivy, 1961; Metha *et al.,* 1967; Bokil *et al.,* 1974) because the extract contains growth promoting hormones (IAA and IBA), cytokinins, trace elements, vitamins and amino acids (Challen and Hemingway, 1965).

Seaweed fertilizer was found to be superior to chemical fertilizer because to the high level of organic matter aids in retaining moisture and minerals in the upper soil level available to roots (Wallen Kemp, 1955). Hence, the present study was undertaken to investigate the effect of different concentrations of *Sargassum wightii* SLF on the growth and biochemical characteristics of *Abelmoschus esculentus*.

Materials and Methods

The seaweed used in the present study was *Sargassum wightii* belonging to the class Phaeophyceae. They were collected from the coastal area of Rameswaram, India (9º25' N and 79º 15' E) during lowtide. The algal species were handpicked and washed thoroughly with seawater to remove all the unwanted impurities and adhering sand particles etc. The seaweed extract were prepared following the method of Bhosle *et al*., (1975). This seaweed extract was treated as 100% concentration. From the 100% seaweed extract, different concentrations (20%, 40%, 60% and 80%) of seaweed liquid fertilizer (SLF) were prepared using distilled water. As the seaweed liquid fertilizer contained organic matter, they were stored at 4ºC. The crop plant, selected for the present study was *Ablemoschus esculentus* belonging to the family Malvaceae. The seeds were collected from Seed Research Station, Vamban, Pudukottai District, Tamil Nadu, India. The seeds with uniform size, colour and weight were chosen for the experimental purpose. The selected seeds were stored in a metal tin as suggested. Ten seeds were soaked in each

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concentration viz., 20%, 40%, 60%, 80% and 100% for 24h and thereafter they were transferred to respective concentration pots. After germination, in each pot three healthy plants were retained and unhealthy plants were removed. After 15 days, observations on the shoot length, root length, fresh weight and dry weight of the plants were recorded and the biochemical characteristics such as chlorophyll content (Arnon, 1949), carotenoid (Mackinney, 1941), protein (Lowry *et al.,* 1951), amino acid (Moore and Stein, 1948), reducing and total sugar content (Nelson, 1944), α - and β - amylases activities (Bernfeld, 1955) was estimated in *A. esculentus*.

Results

The effect of extract of *S. wightii* on germination percentage and growth of *A. esculentus* is presented in Table 1. Seed germination (100%) was found at 20% SLF concentration. The germination percentage increased with concentration upto 20% and thereafter it declined. The maximum shoot length (15.9 cm/seedling), root length (6.4 cm/seedling), fresh weight and dry weight (4.0, 1.2 g/seedling) was also observed at 20% SLF concentration.

Table-1. Effect of seaweed liquid fertilizer (SLF) of *Sargassum wightii* on germination and growth of *Abelmoschus esculentus* seedlings. ± = Strandard Deviation

Growth parameters	Control	SLF Concentration (%)				
		20	40	60	80	100
Germination percentage	85±2.9	100±3.5	96±3.3	92±3.2	80±2.8	68±2.3
Shoot length (cm)	13.2±0.46	15.9±0.55	14.5±0.50	13.2±0.46	12.4±0.43	11.3±0.39
Root length (cm)	4.3±0.15	6.4±0.22	5.6±0.19	5.0±0.17	4.0±0.14	3.2±0.11
Fresh weight (g)	2.5±0.08	4.0±0.14	3.9±0.13	3.2±0.11	2.0±0.07	1.3±0.04
Dry weight (g)	0.6±0.02	1.2±0.04	0.7±0.02	0.5±0.01	0.4±0.01	0.2±0.00

Table-2. Effect of seaweed liquid fertilizer (SLF) of *Sargassum wightii* on biochemical composition of *Abelmoschus esculentus* seedlings. ± = Starndard Deviation

Biochemical parameters	Control	SLF Concentration (%)				
		20	40	60	80	100
Chlorophyll (mg g^{-1} f. wt.)	1.0±0.03	1.8±0.063	1.6±0.056	1.4±0.049	0.7±0.024	0.4±0.014
Carotenoids (mg g^{-1} f. wt.)	0.79±0.027	0.90±0.031	0.74±0.025	0.68±0.023	0.60±0.021	0.52±0.018
Protein (mg g^{-1} f. wt.)	3.2±0.112	4.0±0.14	3.5±0.122	3.3±0.115	3.0±0.105	2.4±0.084
Amino Acid (mg g^{-1} f. wt.)	1.4±0.049	1.7±0.059	1.4±.049	1.0±0.035	0.8±0.028	0.3±0.010
Reducing sugar (mg g^{-1} f. wt.)	5.5±0.192	6.8±0.238	6.2±0.217	5.6±0.196	5.0±0.175	4.6±0.161
Total sugar (mg g^{-1} f. wt.)	10.7±0.374	13.0±0.455	10.4±0.364	9.3±0.325	9.0±0.315	8.3±0.290
α-amylase (µg min^{-1} mg^{-1} protein)	1.4±0.049	3.9±0.136	2.8±0.098	1.2±0.042	0.9±0.031	0.4±0.014
β-amylase (µg min^{-1} mg^{-1} protein)	1.7±0.059	2.6±0.091	1.6±0.056	1.0±0.035	0.6±0.021	0.4±0.014

The data of biochemical parameters are presented in Table 2. The biochemical constituents increased with SLF concentration levels upto 20% and thereafter it declined. The highest values of chlorophyll content (1.8 mg g^{-1} f. wt.), carotenoid (0.90 mg g^{-1} f. wt.), protein content of shoot (4.0 mg g^{-1} f. wt.), amino acid content of shoot (1.7 mg g^{-1} f. wt.), reducing sugar content of shoot (6.8 mg g^{-1} f. wt.), total sugar content of shoot (13.0 mg g^{-1} f. wt.), α-amylase (3.9 µg min^{-1} mg^{-1} protein) and β-amylase 2.6 µg min^{-1} mg^{-1} protein) activities were recorded at 20% *S. wightii* extract.

Discussion

The utilization of seaweed in agriculture and horticulture has a long history. Ancient Greeks and Chinese applied seaweed mulches to the soil. Some of the commercially available liquid seaweed like Cytex, Goemer GA 14, Kelpak 66, Maxicrop sea crop 16, Seaspray, Seamac, Seamagic-3 etc. The *A. esculentus* seeds soaked with lower concentrations of the *S. wightii* extracts showed higher rates of germination, while the higher concentrations of the extracts inhibited the germination. The increased germination percentage at low concentrations may be due to the presence of some growth promoting substances such as IAA and IBA, Gibberellins (A&B), cytokinins, micronutrients, vitamins and amino acids in *S. wightii* extracts. (Challen and Hemingway, 1965). Our findings coincide with those of earlier studies made in *Cajanus cajan* (Mohan *et al.,* 1994), maize, ragi and kumbu (Rajkumar Immanuel and Subramanian, 1999), *Vigna catajung* and *Dolichos biflorus* (Anantharaj and Venkatesalu, 2001, 2002). Statistically significant differences were observed for shoot length, root length, fresh and dry weight. A positive response was observed at 20% SLF of *S. wightii* soaked seedlings.

The increased seedling growth may be due to the presence of Phenyl Acetic Acid (PAA) and other closely related compounds (P-CH-PAA) in the SLF (Taylor and Wilkinson, 1977) as well as the presence of some growth promoting substances. The growth enhancing potential of seaweeds might be attributed to the presence of macro and micronutrients (Challen and Hemingway, 1965). The higher concentrations showed a decreasing trend. Similar results reported on growth in *C. cajan* (Mohan *et al.,* 1994), *Vigna radiate* (Venkataraman Kumar *et al.,* 1993). Also reported similar findings with *Hypnea musciformis*, *Spatoglossum asperum*, *Stoechospermum marginatum* and *Sargassum* on the growth of crops such as green chillies, turnips and pineapple.

The lower concentrations of the seaweed liquid fertilizer (*S. wightii*) also promoted the chlorophyll content of *A. esculentus* upto 20% when compared to control. Higher concentrations decreased the chlorophyll content. A similar observation was made in *Scytonema* sp. (Venkataraman Kumar and Mohan, 1997a), *Vigna mungo*

(Venkataraman Kumar and Mohan, 1997b) and in *Vigna sinensis* (Sivasankari *et al.,* 2006). The seaweed extract applied as foliar spray enhanced the leaf chlorophyll level in plants (Blunden *et al.,* 1996). The highest protein content was recorded at 20% SLF concentration treatment in *A. esculentus*. The increase in the protein content at lower concentration of SLF might be due to absorption of most of the necessary elements by the seedlings (Kannan and Tamilselvan, 1990; Anantharaj and Venkatesalu, 2001, 2002; Sivasankari *et al.,* 2006). The sugar content increased at 20% SLF concentration and the content decreased at higher concentrations. The same trend was observed in the *H. musciformis* with NPK application in blackgram (Tamilselvan and Kannan, 1994) *Vigna catajung* and *Dolichos biflorus* Anantharaj and Venkatesalu, 2001, 2002). It has been observed that the α-amylase activity was higher than the β-amylase activity. The α-amylase and β-amylase activity increased at lower concentrations seaweed extract treatment.

Conclusion

The seaweed extract prepared from *S. wightii* was found to be promising in possessing fertilizer activity. Hence, this simple practice of application of ecofriendly seaweed liquid fertilizers to vegetables is recommended to the farmers for attaining better growth and yield over chemical fertilizers.

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